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# Deutsche Entomologische Zeitschrift

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# Deutsche Entomologische Zeitschrift

## An International Journal of Systematic Etymology

### Instructions for authors

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**Deutsche Entomologische Zeitschrift** is an international peer-reviewed journal of systematic entomology. It publishes original research papers in English on systematics, taxonomy, phylogeny, comparative and functional morphology, as well as biogeography of insects. Other arthropods are only considered where of relevance to the biology of insects. The geographical scope of the journal is worldwide. Priority is given to revisional work and comprehensive studies of phylogenetic, biological or zoogeographical relevance. The journal also welcomes review articles pertaining to systematics and biology of insects.

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# Deutsche Entomologische

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## Zeitschrift

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### 61 (1) 2014

# Deutsche Entomologische Zeitschrift

## An International Journal of Systematic Entomology

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### In Focus

The cover picture shows *Lachnus pseudonudus* Kanturski & Wieczorek, sp. n.

See paper of **Kanturski et al.** A new oak-feeding species of *Lachnus* Burmeister and some remarks on the taxonomic status of *L. chosoni* Szelegiewicz (Hemiptera, Aphididae, Lachninae)

### Cover design

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# Deutsche Entomologische Zeitschrift

## An International Journal of Systematic Entomology

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## Abstract & Indexing Information

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# Jump into the future: Deutsche Entomologische Zeitschrift goes for advanced open access in its 157<sup>th</sup> publishing year

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With the beginning of this year, the Deutsche Entomologische Zeitschrift (DEZ), one of the world's oldest entomology journals, became a front-line fighter of modern scientific publishing. The transfer to Pensoft, the new publisher, brings about changes, as I see it, all for the benefit of the scientific community.

Most obviously, all articles published in the DEZ will henceforth be open access. They thus will have a much wider coverage. This is not only of use for the authors who can freely share and promote their articles and hence benefit from increased citation rates and new collaboration opportunities, but for the whole scientific community as the articles become available to practically everyone, independently of access via a library or a university server. More and more taxonomic works are being published by experts from developing and transitional countries and open access is the only way to provide them with an open and efficient mechanism for exchange and growth of knowledge. Additionally, Pensoft ensures the visibility of published taxonomic information by distributing it to global portals, such as Encyclopedia of Life, Plazi Treatment Repository, the wiki treatment repository Species-ID, and many others. In addition, the authors are saved the bother of registering their new taxa with ZooBank due to the automated

registration workflow firstly established by Pensoft. An important difference from most open access journals is that the open access to the two regular yearly issues of the DEZ is granted to the authors due to the generous support from the Museum für Naturkunde, Berlin.

When I was invited to take over the editorship of the DEZ, it was the perspective of leading the journal into the modern publishing paths of Pensoft that excited me most. You may thus believe that I am proud and honoured to present you with the first issue in the new format. I am personally convinced that this publishing model is the only way to meet the challenges and demands of the present and the future. I thank the leadership of the Museum für Naturkunde and personally Prof. Dr. Johannes Vogel, the Director General, for their confidence and appreciate their commitment to the new path. My predecessor Prof. Dr. Hannelore Hoch has guided the DEZ to where it is now, a recognized systematic entomology journal, and I thank her for her support in continuing her work. Finally, I am glad that I could gather a highly dedicated and excellent editorial team to stand behind me, consisting of both long-serving and newly invited experts.

With this, I would like to invite colleagues from all around the world to enjoy the new publishing services of their well-known good "old" journal!





# Caddisflies (Trichoptera) from Lombok, Bali and Java (Indonesia), with a discussion of Wallace's Line

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## Abstract

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## Key Words

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Caddisflies (Trichoptera) of Southeast Asia are analyzed with special attention to the Sunda Islands to evaluate the zoogeographic effects of island isolation and potential influence from the neighboring continental faunas. Results of recent Trichoptera collections and synopsis of previously published data for the islands of Java, Bali, and Lombok are presented along with their zoogeographical interpretation on the islands as well as on the adjacent regions. A total of 202 Trichoptera species is known to occur on the three islands; 146 species are known in Java, 73 in Bali and 61 in Lombok. 43 species are common to Java and Bali, 27 to Java and Lombok, 30 to Bali and Lombok, 70 to Java and Sumatra. A significant decrease in species richness has been observed in comparison to the Asian mainland. The caddisfly fauna of the three islands is of Asiatic origin, no Australian influence was noted. The well-known Wallace's line does not act as a faunistic border between Bali and Lombok for Trichoptera.

## Introduction

Caddisflies (order Trichoptera) have a complicated distribution in the world, with significant species diversity concentrated in Tropical Asia, especially in the Himalayas (Schmid 1970, 1984; Morse 1997; de Moor and Ivanov 2008). One of the regions of highest faunistic diversity is the area which includes Thailand, Yunnan, northern Myanmar, and northeastern India (Assam, Arunachal Pradesh and surrounding territories). There is a strong decrease of diversity from this region along the Himalayas in a western direction (e.g., Schmid 1970). This high diversity however does not necessarily mean an evolution center of caddisfly groups. It could be a result of local speciation processes in the relatively young mountains. The great tropical diversity of caddisflies is a subject of recent studies (e.g., Mey 2001; Malicky 2010; Malicky et al. 2011), although with the rapid environmental deterioration in the tropics many species may not be discovered and become extinct before they can be described. The faunistics and taxonomy of the tropical faunas has its own

scientific value. Furthermore, such a species-rich aquatic group as Trichoptera can clarify some problems of general zoogeography. One of these problems, the formation and structure of the great transition zone between Asia and Australia, has not been intensively analyzed for Trichoptera previously. The study of this problem requires data on the species composition and distribution for numerous islands between the southeastern end of Asia and the western shores of Australia and New Guinea, the Malay Archipelago, previously known as East Indian Archipelago, including the Sunda Islands and the Molucca Islands.

The amazing species richness and endemism of the Malay Archipelago exists in one of the most geologically dynamic regions of our planet. The geological history of the Malay Archipelago is very complex (Hall 2009; Van Welzen et al. 2011). There were complicated movements of land blocks in the Cenozoic, and most islands in the central Malesian region started to emerge from the sea only some 5 million years ago. Direct use of the geological data to delimit areas in Southeast Asia is difficult because of the climate and sea level changes, which occurred during periods of glaciation.

There are two shallow ocean regions in the western (Sunda Shelf) and eastern (Sahul Shelf) parts of the Malay Archipelago. Past glaciations caused a fall of sea level so that certain vast areas, currently covered by shallow seas, have been parts of continents and have opened migration pathways. The area between Sunda and Sahul Shelves is called Wallacea. When the sea level was lower and the Sunda Shelf was an extension of the Asian continent (Sundaland) and, respectively, the Sahul Shelf connected with Australia, the islands of Wallacea continued to be relatively isolated from the continental land masses. Nevertheless, these islands could have acted as steppingstones for the organisms that were able to cross the narrow straits between them.

A famous boundary dividing the Asian and Australian biotas, Wallace's line, is one of the most disputed topics in biogeography since the end of the XIX century (Camerini 1993) and this concept has been in the focus of intensive discussions during recent decades (de Lattin 1967; Simpson 1977; Van Welzen et al. 2011). Even though some other lines have been introduced to describe the changing species composition of the Wallacea region including the Philippines, Sulawesi, the Lesser Sunda Islands, and Moluccas (Fig.1), Wallace's line is usually referred to as the major divider between the Oriental and Australian biotas. All proposed boundaries were based on the faunal data, mostly if not exclusively on the distribution of birds and mammals, and only recently some of them have been analyzed by botanists (Van Welzen et al. 2011). The most crucial point of Wallace's line is situated in a narrow strait between the two islands called Bali and Lombok. They are the westernmost members of the Lesser Sunda Islands archipelago, adjoining to the southeastern boundary of Java, a member of the Greater Sunda Islands.

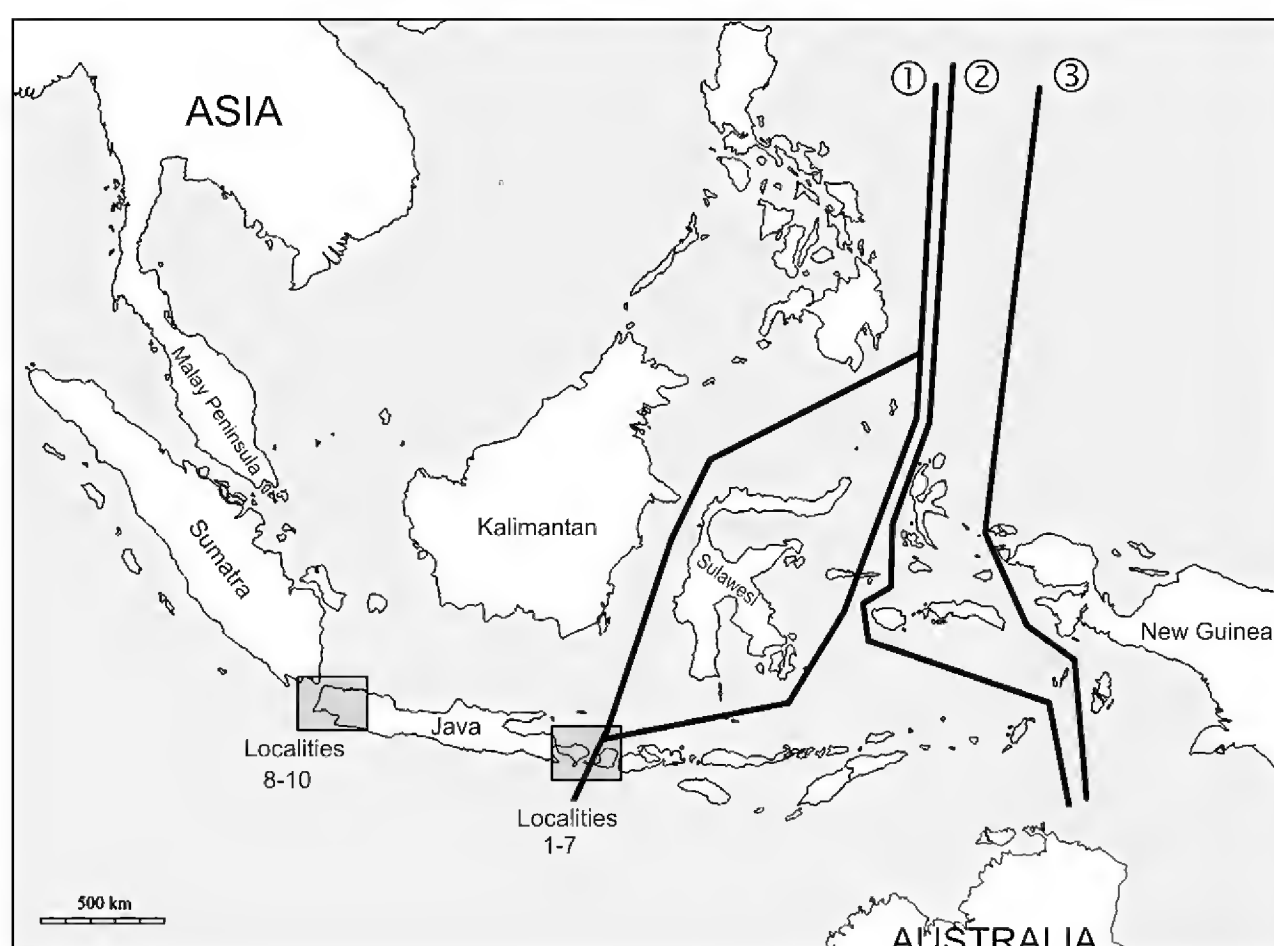
The knowledge of the caddisflies of the Sunda Islands was poor for a long time. The first representative summary was given by Georg Ulmer (1951, 1955, 1957). In this work, the islands of Sumatra, Java, and Bali were con-

sidered, with some minor exceptions. It took nearly half a century that more papers, including several extensive studies, were published, e.g. on Sumatra (Malicky 2007), Java (Malicky 1997, 2002, 2004, 2008, 2009; Malicky and Chantaramongkol 2000, 2006; Wells and Malicky 1997), Bali (Malicky 1995, 1997, 2005, 2006; Malicky and Chantaramongkol 2000, 2006, 2007; Wells 1993) and Lombok (Malicky 2009; Mey 1998, 1999). A survey of the caddisfly fauna of southeastern Asia as a whole was given by Malicky (2010), and the Australasian relationships of Trichoptera faunas were reviewed by Mey (2001).

Nevertheless, the caddisflies of the island of Lombok remained practically unknown, and this is still the state of knowledge of the caddisflies of the islands east of Lombok, including the Moluccas. This was the reason for the members of the Department of Entomology of the State University of St. Petersburg to make collections on the islands of Java, Bali, and Lombok in 2008 and 2009. The species which were new for science have been already described elsewhere (Malicky et al. 2011). This paper presents the complete results of the collections along with some zoogeographic considerations.

## Material and methods

Field collection included the well-known methods of light catch by small water-filled UV traps installed close to the water edge, net sweeping during daytime in the riparian vegetation, and hand picking. Only adults were collected; larvae and pupae were left for future investigations. The material is preserved in 70% ethanol and is stored in the collections of the Zoological Institute of the Russian Academy of Sciences in St. Petersburg. Some specimens are in the collection of the first author. Data from the faunistic publications and some material from the Malicky collection have been used for the analysis of zoogeography and species distribution.



**Figure 1.** Malay Archipelago, sampling areas (rectangles), and the major biogeography divider lines: **1** – Wallace's lines (divergence around Sulawesi Island is caused by the changing views of Wallace, while the western branch is currently accepted as the canonic one), **2** – Weber's line, **3** – Lydekker's line. Wallacea is delimited by Wallace's and Lydekker's lines.

Sampling localities were as follows:

**LOCALITY 1:** Lombok, Senaru, Sindanggala waterfall, Tiu Kelep waterfall and irrigation canal, 08°18'09"S, 116°24'30"E (Sindanggala waterfall, 455 m, lowest point), 08°18'29"S, 116°24'27"E (irrigation channel, 508m, highest point), 2–4 March 2008, at light and net sweeping, leg. V.D. Ivanov and S.I. Melnitsky; Lombok, Senaru, 19–26 September 2009, leg. N. Yu. Kluge. There were 5 biotopes situated close to each other: 2 of them were large waterfalls, one was a shallow rapid tropical river with stony bed in a deep canyon, and another one was an irrigation channel with fast running water and stony bottom some 30 m above the river. Several new species of *Tinodes* and *Hydropsyche* were present only near a leakage from the irrigation channel flowing down the mountain slope.

**LOCALITY 2:** Lombok, Sembalung Lawang, 08°21'37"S, 116°32'17"E, h=1160 m, 5 March 2008, at light, leg. V.D. Ivanov and S.I. Melnitsky. An irrigation channel with warm water in a flat mountain terrace surrounded by fields and shore bushes.

**LOCALITY 3:** Lombok, vic. Kembangkuning, 7 March 2008, 08°30'40"S, 116°25'23"E, h=835–875 m. Rinjani National Park, Jeruk Manis waterfall, at light and net sweeping, leg. V.D. Ivanov and S.I. Melnitsky. A high waterfall and a short piece (approximately 100 m) of rapid river below it followed by cascading waterfalls downstream.

**LOCALITY 4:** Lombok, vic. Kembangkuning, 2 km N Kotaraja, 08°33'33"S, 116°25'23"E h=490 m, river and irrigation canal, 8 March 2008, at light and net sweeping, leg. V.D. Ivanov and S.I. Melnitsky. An irrigation complex including a river with rapids and reaches in a deep canyon with an irrigation channel originating at the water divider.

**LOCALITY 5:** Lombok, Pelangan Barat, near mt. Embit, 08°48'23"S, 115°56'24"E, h=20 m, 11 March 2008, at light, leg. V.D. Ivanov and S.I. Melnitsky. Shallow muddy slowly running and warm river nearby the village Pelangan Barat.

**LOCALITY 6:** Bali, Gitgit waterfall, 08°11'34"S, 115°08'04"E, h=520 m, 14–15 March 2008, at light and net sweeping, leg. V.D. Ivanov and S.I. Melnitsky. Cascading waterfalls above the sampling place followed by a rapid river with large boulders.

**LOCALITY 7:** Bali, Munduk, Melanting waterfall, 08°15'27"S, 115°04'12"E, h=700–900 m, 16–17 March 2008, at light and net sweeping, leg. V.D. Ivanov and S.I. Melnitsky. A river and an irrigation channel originating right below a large waterfall in deep canyon.

**LOCALITY 8:** Java, Bogor, Sadame river, Botanical Garden, 06°35'34"S, 106°48'06"E, h=250 m, 23 February 2008, at light, leg. V.D. Ivanov and S.I. Melnitsky. Large warm muddy river crossing the Bogor Botanical Garden; rapids at the bridge below the garden.

**LOCALITY 9:** Java, Ciapus, Gunung Salak, 06°39'29"S, 106°44'55"E, h=625 m, 24 February 2008, leg. V.D. Ivanov and S.I. Melnitsky. A brook with stony bottom above a small unstable river on the northern slope of Salak volcano.

**LOCALITY 10:** Java, Cipanas, 30 km SE Bogor, 6°42'43"S, 107°01'12"E, h=1100 m, 25–26 February 2008, 06°42'S, 107°01'E, leg. V.D. Ivanov and S.I. Melnitsky; Java, Cipanas, Cibodas, 6–11 August 2009, leg. N. Yu. Kluge. A small river in a rural environment.

**Table 1.** List of species known from Java, Bali and Lombok, with new records

Abbreviations: B – Borneo, P – Peninsular Malaysia, S – Sumatra, Wd – wide distribution; m – males, f – females.

Taxa/family, species	Java	Bali	Lombok	other	Found in localities (Loc)
<b>RHYACOPHILIDAE Stephens, 1836</b>					
<i>Rhyacophila anakbatukau</i> MALICKY, 1995		+	+		Loc.1:5m,1f; Loc.7:1m
<i>Rhyacophila curvata</i> MORTON, 1900	+	+	+	S, P	Loc.1:1m; Loc.3: (1f); Loc.6: 1m; Loc.7:1m
<i>Rhyacophila lieftincki</i> ULMER, 1951	+				
<b>GLOSSOSOMATIDAE Wallengren, 1891</b>					
<i>Glossosoma gera</i> MALICKY & CHANTARAMONGKOL, 2009	+				
<i>Glossosoma kerambos</i> MALICKY, 2004	+				
<i>Agapetus abbreviatus</i> ULMER, 1913	+	+	+		Loc.1:21m, 159f; Loc.3:2m, 5f; Loc.4:7m, 19f; Loc.6:17m, 26f; Loc.7:10f; Loc.8:3m; Loc.9:2m, 15f
<i>Agapetus antilochos</i> MALICKY, 1998	+				
<i>Agapetus cataractae</i> ULMER, 1951	+				Loc.10:2m
<i>Agapetus kekrops</i> MALICKY, 2004	+				
<b>HYDROPTILIDAE Stephens, 1836</b>					
<i>Hydroptila baukis</i> MALICKY, 1998	+				
<i>Hydroptila crenata</i> ULMER, 1951	+			S	
<i>Hydroptila elongata</i> ULMER, 1951	+				

Taxa/family, species	Java	Bali	Lombok	other	Found in localities (Loc)
<i>Hydroptila pinal</i> WELLS & HUISMAN, 1992	+			B, P, S	
<i>Hydroptila rahel</i> MALICKY, IVANOV & MELNITSKY, 2011			+		Loc.4:12m
<i>Hydroptila ruben</i> MALICKY, IVANOV & MELNITSKY, 2011		+			Loc.7:1m, (5f)
<i>Hydroptila rumpun</i> WELLS & HUISMAN, 1992			+	P, S	Loc.4:5m
<i>Hydroptila sphinx</i> MALICKY & CHANTARAMONGKOL, 2007		+		S	
<i>Hydroptila tong</i> WELLS & MALICKY, 1997		+		S	
<i>Hydroptila trullata</i> ULMER, 1951	+			P, S	
<i>Microptila innokentiyi</i> MALICKY, IVANOV & MELNITSKY, 2011			+		Loc.1:3m
<i>Microptila pasak</i> WELLS, 1993		+			
<i>Microptila rinjani</i> MALICKY, IVANOV & MELNITSKY, 2011			+		Loc.1:1m
<i>Microptila taji</i> WELLS, 1993		+			
<i>Tricholeiochiton fortensis</i> ULMER, 1951	+			P, S	
<i>Oxyethira bogambara</i> SCHMID, 1958		+		B, P, S, Wd	
<i>Oxyethira incana</i> ULMER, 1906	+			P, S	
<i>Ugandatrichia kebumen</i> WELLS & MALICKY, 1997	+				
<i>Orthotrichia curvata</i> ULMER, 1951	+	+	+		Loc.4:1m; Loc.8:16m, (numerous f); Loc.10:4m, (13f)
<i>Orthotrichia indica</i> MARTYNOV, 1935	+			S, P, Wd	
<i>Orthotrichia jethran</i> MALICKY, IVANOV & MELNITSKY, 2011			+		Loc.4:2m
<i>Orthotrichia litoralis</i> ULMER, 1951	+	+		S, P, Wd	
<i>Orthotrichia maeandrica</i> ULMER, 1951	+			P, S	
<i>Orthotrichia ranauana</i> ULMER, 1951	+	+		S	
<i>Saranganotrichia decussata</i> ULMER, 1951	+				
<i>Scelotrichia jari</i> WELLS & HUISMAN, 1993			+	B, P	Loc.1:4m; Loc.4:1m
<i>Scelotrichia milka</i> MALICKY, IVANOV & MELNITSKY, 2011			+		Loc.4:1m, (1f)
<i>Scelotrichia nikolayi</i> MALICKY, IVANOV & MELNITSKY, 2011			+		Loc.1:1m, (1f); Loc.4:1m
<i>Scelotrichia saranganica</i> ULMER, 1951	+		+	S	Loc.1:17m, (3f); Loc.4:1m; Loc.10:1m, (2f)
<i>Chrysotrichia piring</i> WELLS, 1993		+			
<i>Chrysotrichia sukamade</i> WELLS & MALICKY, 1997	+			S	
<i>Chrysotrichia terpisaduri</i> WELLS, 1993		+			
<i>Chrysotrichia trisula</i> WELLS, 1993	+				
<i>Plethus baliana</i> ULMER, 1951	+	+			
<i>Plethus berbulu</i> WELLS, 1993		+			
<i>Plethus cruciatus</i> ULMER, 1951	+	+	+	S	Loc.1:2m; Loc.6:59m, numerous f
<i>Parastactobia duatali</i> WELLS & MALICKY, 1997	+	+	+		Loc.1:1m
<i>Stactobia bersisik</i> WELLS, 1993	+	+	+		Loc.4:2m Loc.6:1m
<i>Stactobia betiri</i> WELLS & MALICKY, 1997	+				
<i>Stactobia crassa</i> ULMER, 1951	+				
<i>Stactobia germani</i> MALICKY, IVANOV & MELNITSKY, 2011			+		Loc.4:1m
<i>Stactobia keluk</i> WELLS, 1993	+	+			
<b>PHILOPOTAMIDAE Stephens, 1829</b>					
<i>Chimarra anam</i> MALICKY, 2008		+		S	
<i>Chimarra ard</i> MALICKY, 2008	+				
<i>Chimarra arkit</i> MALICKY, 2008	+				
<i>Chimarra batukaua</i> MALICKY, 1995	+	+	+		Loc.1:4m, 41f; Loc.5:1m; Loc.6:15m, 68f; Loc.4:43m, 193f
<i>Chimarra berenike</i> MALICKY, 1998	+				
<i>Chimarra briseis</i> MALICKY, 1998	+		+	S	Loc.1:2m
<i>Chimarra Chiangmaiensis</i> MALICKY & CHANTARAMONGKOL, 1989		+		P	
<i>Chimarra concolor</i> ULMER, 1951	+			S	Loc.10:1m, (1f)
<i>Chimarra gunungkawi</i> MALICKY, 1995	+	+			
<i>Chimarra jacobsoni</i> ULMER, 1951	+	+			
<i>Chimarra mahalaleel</i> MALICKY, IVANOV & MELNITSKY, 2011			+		Loc.5:1m

Taxa/family, species	Java	Bali	Lombok	other	Found in localities (Loc)
<i>Chimarra sythoffi</i> ULMER, 1951	+				
<i>Chimarra thienemanni</i> ULMER, 1951	+	+		P, S	
<i>Chimarra xumappa</i> MALICKY, IVANOV & MELNITSKY, 2011		+			Loc.7:1m, 2f
<i>Chimarra yskal</i> MALICKY, 1989		+			
<i>Gunungiella aguha</i> MELNITSKY & IVANOV, 2010			+		Loc.1:7m, 1f; Loc.3:1m
<i>Gunungiella britomartis</i> MALICKY, 1998	+				
<i>Gunungiella kalliope</i> MALICKY, 2004	+				
<i>Gunungiella reducta</i> ULMER, 1913	+				
<i>Pseudoneureclipsis ramosa</i> ULMER, 1913	+	+	+	P, S, Wd	Loc.1:3m, 6f; Loc.3:2f; Loc.4:3f; Loc.7:5m, 3f
<b>POLYCENTROPODIDAE Ulmer, 1903</b>					
<i>Polyplectropus gedehensis</i> ULMER, 1951		+			
<i>Polyplectropus jahzeel</i> MALICKY & MEY, 2011		+			
<i>Polyplectropus javanicus</i> ULMER, 1905	+			S	
<i>Polyplectropus kristyantoi</i> MALICKY, 1998	+				
<i>Nyctiophylax baydeom</i> MALICKY, IVANOV & MELNITSKY, 2011	+				Loc.9:1m
<b>ECNOMIDAE Ulmer, 1903</b>					
<i>Ecnomus anakagung</i> MALICKY, 1995	+	+			Loc.10:1m
<i>Ecnomus jethet</i> MALICKY, IVANOV & MELNITSKY, 2011			+		
<i>Ecnomus obtusus</i> ULMER, 1910	+			S	
<i>Ecnomus quordaio</i> MALICKY, 1993	+			S, P	Loc.8:2m, (1f)
<i>Ecnomus robustior</i> ULMER, 1951	+			P, S	
<i>Ecnomus serratus</i> ULMER, 1930	+	+		S	
<i>Ecnomus tjurupensis</i> ULMER, 1951	+			S	
<i>Pseudoneureclipsis ramosa</i> ULMER, 1913	+	+	+	P, S, Wd	Loc.1:3m, 6f; Loc.3:2f; Loc.4:3f; Loc.7:5m, 3f
<b>PSYCHOMYIIDAE Walker, 1852</b>					
<i>Paduniella kalamos</i> MALICKY, 2004	+	+	+	S	Loc.1:27m, (23f); Loc.2:1m; Loc.3:9m, (1f); Loc.4:15m; Loc.7:9m, (4f); Loc.9:1m, (10f)
<i>Paduniella koehleri</i> MALICKY, 1995	+	+	+		Loc.5:3m; Loc.8:1m, (5f)
<i>Paduniella semarangensis</i> ULMER, 1913	+	+		S, P	
<i>Paduniella trichobogiella</i> MALICKY, IVANOV & MELNITSKY, 2011			+		Loc.4:3m
<i>Psychomyia anaksusuan</i> MALICKY, 1995		+			
<i>Psychomyia capillata</i> ULMER, 1910	+			P, S	
<i>Psychomyia feuerborni</i> ULMER, 1951	+	+	+	S	Loc.1:1m; Loc.4:4m; Loc.6:16m, 16f
<i>Psychomyia kalais</i> MALICKY, 2004	+				Loc.9:7m; Loc.10:5m, (3f)
<i>Psychomyia monto</i> MALICKY & CHANTARAMONGKOL, 1993	+			P	
<i>Psychomyia thienemanni</i> ULMER, 1951	+			P, S	
<i>Tinodes dedan</i> MALICKY, 2009	+				
<i>Tinodes flavopunctatus</i> ULMER, 1910	+	+			Loc.7:6m; Loc.8:2m, (5f); Loc.9:3m, (9f); Loc.10:1m
<i>Tinodes ihalauwi</i> MALICKY, 1998	+				
<i>Tinodes katreus</i> MALICKY, 2004	+				
<i>Tinodes kawiensis</i> MALICKY, 1995		+	+		Loc.1:16m; Loc.3:1m; Loc.6:1m
<i>Tinodes kepheus</i> MALICKY, 2004	+				
<i>Tinodes luhurensis</i> MALICKY, 1995		+	+		Loc.1:47m, (9f); Loc.4:20m, (46f)
<i>Tinodes mataram</i> MALICKY, IVANOV & MELNITSKY, 2011			+		Loc.1:52m; Loc.2:1m
<i>Tinodes methusael</i> MALICKY, IVANOV & MELNITSKY, 2011			+		Loc.1:1m; Loc.4:2m
<i>Tinodes moab</i> MALICKY, IVANOV & MELNITSKY, 2011	+				Loc.10:1m
<i>Tinodes noah</i> MALICKY, IVANOV & MELNITSKY, 2011	+				Loc.10:1m
<i>Tinodes prihatmoi</i> MALICKY, 1998	+				
<i>Tinodes pujungan</i> MALICKY, 1995		+			Loc.7:5m, (3f)
<i>Tinodes saul</i> MALICKY, IVANOV & MELNITSKY, 2011	+				Loc.8:5m; Loc.10:3m
<i>Tinodes simeon</i> MALICKY, IVANOV & MELNITSKY, 2011	+				Loc.9:5m, (7f)
<i>Tinodes tegenungan</i> MALICKY, 1995		+			
<i>Tinodes timotii</i> MALICKY, 1998	+				
<i>Tinodes zibeon</i> MALICKY, IVANOV & MELNITSKY, 2011			+		Loc.1:1m
<i>Trawaspsyche weilgunii</i> MALICKY, 2004	+				

Taxa/family, species	Java	Bali	Lombok	other	Found in localities (Loc)
<b>XIPHOCENTRONIDAE Ross, 1949</b>					
<i>Melanotrichia samaconius</i> MALICKY & CHANTARAMONGKOL, 1992	+	+		P	Loc.6:11m
<b>HYDROPSYCHIDAE Curtis, 1835</b>					
<i>Diplectrona aspersa</i> ULMER, 1905	+				
<i>Diplectrona aurovittata</i> ULMER, 1906	+	+	+	P, S	Loc.1:5m, 2f
<i>Diplectrona extrema</i> BANKS, 1920	+			K, S	
<i>Diplectrona jacobsoni</i> ULMER, 1909	+			S	
<i>Diplectrona lavinia</i> MALICKY, 2002	+			B	
<i>Diplectrona pseudofasciata</i> ULMER, 1909	+			B, S, P, Wd	
<i>Diplectrona salakensis</i> ULMER, 1951	+				
<i>Diplectrona ungaranica</i> ULMER, 1951	+			S	
<i>Oestropsyche vitrina</i> HAGEN, 1859	+	+		B, S, P, Wd	
<i>Polymorphanisus nigricornis</i> WALKER, 1852	+			P, S, Wd	
<i>Polymorphanisus ocularis</i> ULMER, 1906	+			B, P, S, Wd	
<i>Polymorphanisus scutellatus</i> BANKS, 1939	+			B, S,	
<i>Macrostemum fastosum</i> WALKER, 1852	+	+		P, S, Wd	Loc.7:2f
<i>Macrostemum fenestratum</i> ALBARDA, 1887	+			B, P, S	
<i>Amphipsyche meridiana</i> ULMER, 1909	+			P, S, Wd	
<i>Amphipsyche petiolata</i> ULMER, 1930	+			B, P, S	
<i>Hydromanicus dilatus</i> BETTEN, 1909	+				
<i>Hydromanicus flavoguttatus</i> ALBARDA, 1881	+			S	
<i>Hydromanicus irroratus</i> BRAUER, 1865	+				
<i>Hydromanicus ornatus</i> ULMER, 1951	+				
<i>Hydromanicus unicolor</i> ULMER, 1951	+				
<i>Potamyia aureipennis</i> ULMER, 1930	+			S	Loc.8:16m
<i>Potamyia dentifera</i> ULMER, 1930	+				
<i>Potamyia flavata</i> BANKS, 1934	+	+	+	P, S	Loc.4:(5f); Loc.5:1m, 22f
<i>Cheumatopsyche brevis</i> ULMER, 1930	+				
<i>Cheumatopsyche concava</i> ULMER, 1930	+	+		S	Loc.6:(2f); Loc.7:8m, (40f)
<i>Cheumatopsyche contexta</i> ULMER, 1951	+			B, S	
<i>Cheumatopsyche dodan</i> MALICKY & MEY, 2009			+		Loc.1:1m
<i>Cheumatopsyche globosa</i> ULMER, 1910	+	+		B, S, P	
<i>Cheumatopsyche kebumena</i> MALICKY, 1997	+				
<i>Cheumatopsyche kraepelini</i> ULMER, 1905	+	+			
<i>Cheumatopsyche lucida</i> ULMER, 1907	+	+	+	B, P, S, Wd	Loc.4:1m, (6f); Loc.5:7m, (25f); Loc.8:23m, (28f)
<i>Cheumatopsyche misma</i> MALICKY, IVANOV & MELNITSKY, 2011			+		Loc.1:2f
<i>Cheumatopsyche sindanggala</i> MALICKY, IVANOV & MELNITSKY, 2011			+		Loc.1:8m, (227f); Loc.4:3m, (6f)
<i>Hydropsyche annulata</i> ULMER, 1905	+	+			Loc.6:1m; Loc.8:26m, (numerous f); Loc.9:1m, (12f); Loc.10:2m, (4f)
<i>Hydropsyche bryanti</i> BANKS, 1939	+			S	
<i>Hydropsyche didyma</i> MEY, 1999			+		Loc.1:8m, (20f); Loc.3:3m, (4f)
<i>Hydropsyche doctersi</i> ULMER, 1951	+			P	
<i>Hydropsyche irroratella</i> ULMER, 1951	+			B?	
<i>Hydropsyche javanica</i> ULMER, 1905	+				
<i>Hydropsyche kottos</i> MALICKY, 2004	+				
<i>Hydropsyche mesech</i> MALICKY, IVANOV & MELNITSKY, 2011		+			Loc.7:4m, (4f)
<i>Hydropsyche renschi</i> MEY, 1999		+	+	S	Loc.1:1m; Loc.4:3m, (3f); Loc.6:1m
<i>Hydropsyche saranganica</i> ULMER, 1951	+	+	+	S, Wd	Loc.1:1m; Loc.4:2m; Loc.6:4m, (11f)
<i>Hydropsyche sasakorum</i> MALICKY, IVANOV & MELNITSKY, 2011			+		Loc.1:6m, (3f); Loc.3:4m, (5f); Loc.4:1m
<i>Hydropsyche sinear</i> MALICKY, IVANOV & MELNITSKY, 2011			+		Loc.3:1m



Taxa/family, species	Java	Bali	Lombok	other	Found in localities (Loc)
<i>Hydropsyche staphylostirpis</i> MEY, 1998			+		
<b>LEPIDOSTOMATIDAE Ulmer, 1903</b>					
<i>Lepidostoma brevior</i> ULMER, 1913	+	+		S	Loc.7:1m
<i>Lepidostoma conjunctum</i> BANKS, 1934	+			B, S	
<i>Lepidostoma diehli</i> WEAVER, 1989		+	+	S	Loc.1:8m, 3f
<i>Lepidostoma jacobsoni</i> ULMER, 1910	+			S	
<i>Lepidostoma kephalos</i> MALICKY, 2004	+				
<i>Lepidostoma lombokensis</i> MALICKY, IVANOV & MELNITSKY, 2011			+		Loc.1:1m, (1f)
<i>Lepidostoma picea</i> ULMER, 1913	+	+		S	Loc.7:2m, 2f
<b>BRACHYCENTRIDAE Ulmer, 1903</b>					
<i>Micrasema ripat</i> MALICKY, IVANOV & MELNITSKY, 2011	+				Loc.10:1m
<b>GOERIDAE Ulmer, 1903</b>					
<i>Goera conclusa</i> ULMER, 1905	+	+	+		Loc.1:3m, 1f
<i>Goera pugnio</i> ULMER, 1951	+	+		S?	Loc.6:1m
<i>Goera ranauana</i> ULMER, 1951	?			S	
<i>Gastrocentrides sumatranus</i> ULMER, 1930	+	+	+	S, P, Wd	Loc.4:1f; Loc.7:2m, 3f
<b>HELICOPSYCHIDAE Ulmer, 1906</b>					
<i>Helicopsyche lata</i> ULMER, 1951	+			S, P	
<b>LEPTOCERIDAE Leach, 1815</b>					
<i>Adicella byblis</i> MALICKY, 1998	+		+	S	Loc.1:14m, 9f; Loc.4:2m
<i>Adicella evadne</i> SCHMID, 1994		+	+	S, P, Wd	Loc.4:4m; Loc.7:1m
<i>Adicella kanake</i> MALICKY & CHANTARAMONGKOL, 2002			+	S, P	Loc.1:3m, (5f)
<i>Adicella pulcherrima</i> ULMER, 1906	+			S	
<i>Adicella oviformis</i> ULMER, 1951	+	+			
<i>Leptocerus ciconiae</i> MALICKY, 1993		+		S, P	
<i>Setodes karnyi</i> ULMER, 1930		+	+	S	Loc.1:1m
<i>Setodes klakahanus</i> ULMER, 1951	+	+	+		Loc.4:1m; Loc.5:1m
<i>Setodes larentia</i> MALICKY & CHANTARAMONGKOL, 2006	+		+	S	Loc.4:2m, (4f); Loc.7:1m, (5f)
<i>Setodes nauplios</i> MALICKY & CHANTARAMONGKOL, 2006	+				
<i>Setodes uncinatus</i> ULMER, 1913	+			S	
<i>Trichosetodes handschini</i> ULMER, 1951	+				Loc.8:11m, (6f); Loc.9:2m, (5f)
<i>Oecetis karnyi</i> MALICKY, 2009	+				
<i>Oecetis kyparissos</i> MALICKY, 2005		+	+		Loc.4:2m, 9f; Loc.5:1m
<i>Oecetis pelops</i> MALICKY, 2006		+	+		Loc.3(1f); Loc.7:(16f)
<i>Oecetis singularis</i> ULMER, 1930	+			S	
<i>Oecetis spatula</i> CHEN & MORSE, 1991	+			Wd	
<i>Oecetis tripunctata</i> FABRICIUS, 1793	+	+	+	B, P, S, Wd	Loc.4:1m, 6f
<i>Tagalopsyche brunnea</i> ULMER, 1905	+		+	B, S, P	Loc.4:1m
<i>Triaenodes pelias</i> MALICKY, 2005	+			S	
<i>Parasetodes respersella</i> RAMBUR, 1842		+		B, P, S, Wd	
<i>Triplectides indica</i> WALKER, 1852	+		+	S, P, Wd	Loc.4:5f
<b>CALAMOCERATIDAE Ulmer, 1905</b>					
<i>Anisocentropus flavomarginatus</i> ULMER, 1906	+			B, S	
<i>Anisocentropus handschini</i> ULMER, 1951	+				
<i>Anisocentropus ulmeri</i> MALICKY, 1998	+				
<i>Ganonema fuscipenne</i> ALBARDA, 1881	+	+	+	P, S	Loc.1:1f; Loc.4:1f; Loc.6:3m
<b>ODONTOCERIDAE Wallengren, 1891</b>					
<i>Marilia javana</i> ULMER, 1951	+				
<i>Marilia sumatrana</i> ULMER, 1951	+			S	
Total: 202 species	146	73	61		Collected by V.Ivanov, S.Melnitsky, N. Kluge: 84 species

Results and discussion

Table 1 gives the complete list of specimens with data on the sample localities and the distribution outside the studied region. The maps (Figs 2–4) show the position of the localities. In Table 2 a survey is given on genera and families of all Trichoptera identified to species level known from the three islands in comparison to the better studied neighboring regions. Many specimens, mainly females, could not be identified to species. Two species require additional remarks. The types of the microcaddisflies *Plethus acutus* Ulmer and *P. cruciatus* Ulmer have been studied by one of us (H. Malicky) in the Hamburg museum. The type material shows no difference

between these species hence we omit one of them (*P. acutus*) in our counts as probable junior synonym. The genus *Marilia* (Odontoceridae) is insufficiently studied in the region. Two species are known from Java (Table 1), but have not been collected on Lombok and Bali. The taxonomy of this genus suffers from the absence of good characters for identification. We do not include this family and genus in Table 2 because the count of species in Asian mainland (Thailand and Malaysia) and Sumatra would not provide good results until this genus has been revised. All data on total species counts are considered here as preliminary. Any further collection is expected to provide more species new for science as well as new regional records.

Table 2. Synopsis of the number of species in Thailand, Sumatra, Java, Bali, and Lombok (except Odontoceridae: see text)

Taxa/family, genus	Thailand	Sumatra	Java	Bali	Lombok
<b>RHYACOPHILIDAE</b>					
<i>Rhyacophila</i>	37	7	3	2	2
<b>GLOSSOSOMATIDAE</b>					
<i>Glossosoma</i>	3	2	2	0	0
<i>Agapetus</i>	14	5	4	1	1
<b>HYDROPTILIDAE</b>					
<i>Hydroptila</i>	33	14	5	3	2
<i>Microptila</i>	2	0	0	2	2
<i>Tricholeiochiton</i>	1	1	1	0	0
<i>Oxyethira</i>	4	4	1	1	0
<i>Ugandatrichia</i>	5	1	1	0	0
<i>Orthotrichia</i>	32	11	5	3	2
<i>Saranganotrichia</i>	2	0	1	0	0
<i>Scelotrichia</i>	5	3	1	0	4
<i>Chrysotrichia</i>	13	5	2	2	0
<i>Plethus</i>	9	1	2	3	1
<i>Parastactobia</i>	2	1	1	1	1
<i>Stactobia</i>	7	0	4	2	2
<b>PHILOPOTAMIDAE</b>					
<i>Chimarra</i>	60	21	10	8	3
<i>Gunungiella</i>	9	3	3	0	1
<b>STENOPSYCHIDAE</b>					
<i>Stenopsyche</i>	8	1	0	0	0
<b>POLYCENTROPODIDAE</b>					
<i>Polyplectropus</i>	13	14	2	2	0
<i>Nyctiophylax</i>	20	6	1	0	0
<b>ECNOMIDAE</b>					
<i>Ecnomus</i>	51	16	6	2	1
<i>Pseudoneureclipsis</i>	41	5	1	1	1
<b>PSYCHOMYIIDAE</b>					
<i>Paduniella</i>	13	2	3	3	3
<i>Psychomyia</i>	24	10	5	2	1
<i>Tinodes</i>	19	5	11	5	5
<i>Trawaspsyche</i>	0	0	1	0	0
<b>XIPHOCENTRONIDAE</b>					
<i>Melanotrichia</i>	4	1	1	1	0
<b>HYDROPSYCHIDAE</b>					
<i>Diplectrona</i>	8	10	8	1	1
<i>Oestropsyche</i>	1	1	1	1	0
<i>Polymorphanisus</i>	5	5	3	0	0
<i>Macrostemum</i>	12	8	2	1	0
<i>Amphipsyche</i>	2	3	2	0	0



Taxa/family, genus	Thailand	Sumatra	Java	Bali	Lombok
<i>Hydromanicus</i>	13	5	5	0	0
<i>Potamyia</i>	13	3	3	1	1
<i>Cheumatopsyche</i>	29	11	7	4	4
<i>Hydropsyche</i>	30	13	7	4	6
<b>LEPIDOSTOMATIDAE</b>					
<i>Lepidostoma</i>	41	15	5	3	2
<b>BRACHYCENTRIDAE</b>					
<i>Micrasema</i>	6	0	1	0	0
<b>GOERIDAE</b>					
<i>Goera</i>	16	6	2	2	1
<b>HELICOPSYCHIDAE</b>					
<i>Helicopsyche</i>	14	3	1	0	0
<b>LEPTOCERIDAE</b>					
<i>Adicella</i>	20	12	3	2	3
<i>Leptocerus</i>	42	8	0	1	0
<i>Setodes</i>	63	17	4	2	3
<i>Trichosetodes</i>	7	3	1	0	0
<i>Oecetis</i>	50	39	4	3	3
<i>Tagalopsyche</i>	3	3	1	0	1
<i>Triaenodes</i>	11	5	1	0	0
<i>Parasetodes</i>	1	1	0	1	0
<i>Tripletides</i>	1	1	1	0	1
<b>CALAMOCERATIDAE</b>					
<i>Anisocentropus</i>	10	5	3	0	0
<i>Ganonema</i>	4	1	1	1	1

The caddisfly faunas of the three islands correspond quite well. It is evident from the Tables 1 and 2 that, according to our present knowledge, the fauna of caddisflies known for the larger and more diverse Java Island is more comparable to faunas of small islands of the Lesser Sunda Archipelago in numbers of species: the total number of species found on Java (146) exceeds the fauna of Bali 2 times (73) and has 2.4 times more species than small Lombok Island (61). The number and proportion of species on Java is probably much greater than this, but the small number is probably caused by a relatively poor exploration of Java compared to the two islands. The species shared by these faunas are counted as 43 species found on both Java and Bali, and 27 found on both Java and Lombok. The similar counts give 30 species occurring on both Bali and Lombok, and 70 on Java and Sumatra. The total number of caddisfly species known on the three islands is 202. However, one could expect that some of these species will also be found later on the adjoining islands in more intensive collection. Hence, the calculation of the similarity of the faunas is left for the future when more data will be available on the fauna of eastern Java and on the species emerging in dry season (May to September) on Lombok.

Surprises are also possible when species described from far distant regions will be found. For example, *Adicella kanake* Malicky & Chantaramongkol and *Hydrop-tila rumpun* Wells & Huisman found on Lombok were known previously from Sumatra, Peninsular Malaysia and Thailand, but were never collected on Java and Bali. The microcaddisfly *Scelotrichia jari* Wells & Huisman

from Lombok lives on Borneo (or Kalimantan Island on some maps) and Peninsular Malaysia but was not found on Java and Bali. Similarly, *Paduniella dendrobia* Malicky & Chantaramongkol was described from high altitude of Doi Inthanon in northern Thailand and *Phoupanpsyche caroli* Malicky was described from the mountains of Laos, but both were later found in the higher elevations of Mount Kinabalu on Borneo, several thousands of kilometers away. There are some instances of species like *Hydropsyche renschi* Mey and *Lepidostoma diehl* (Weaver) found on both Lombok and Bali but not on Java Island.

Endemics of generic or even more-inclusive categories may scarcely exist on these islands. The genus *Trawaspsyche* with the single species *T. weilgunii* Malicky, which is an extremely derived form in relationship with *Tinodes*, is known only from Java. Similar cases are *Temburongpsyche* on Borneo and *Padangpsyche* and *Edidiehlia* on Sumatra. Neither an evolution center nor numerous centers can be recognized on the three islands. A relatively high number of *Tinodes* species may mean a rather active and recent regional speciation process.

Continuous impoverishment of the Asiatic mainland faunas in the direction of the Lesser Sunda Islands is obvious (Table 2). In Thailand, over 1000 species are presently known (Chantaramongkol et al. 2010); in Sumatra, an island of about the same size, there are about 350 species. In Java we know 146, in Bali 73, and in Lombok 61 species (Malicky 2010 and this paper). Besides the decrease of the total number of species towards the southeast, one can see a notable decrease in the number

of genera or families, e.g., Macronematinae, and Odonotocerae. The example of Macronematinae is especially remarkable because these strong flyers are present in New Guinea and Australia.

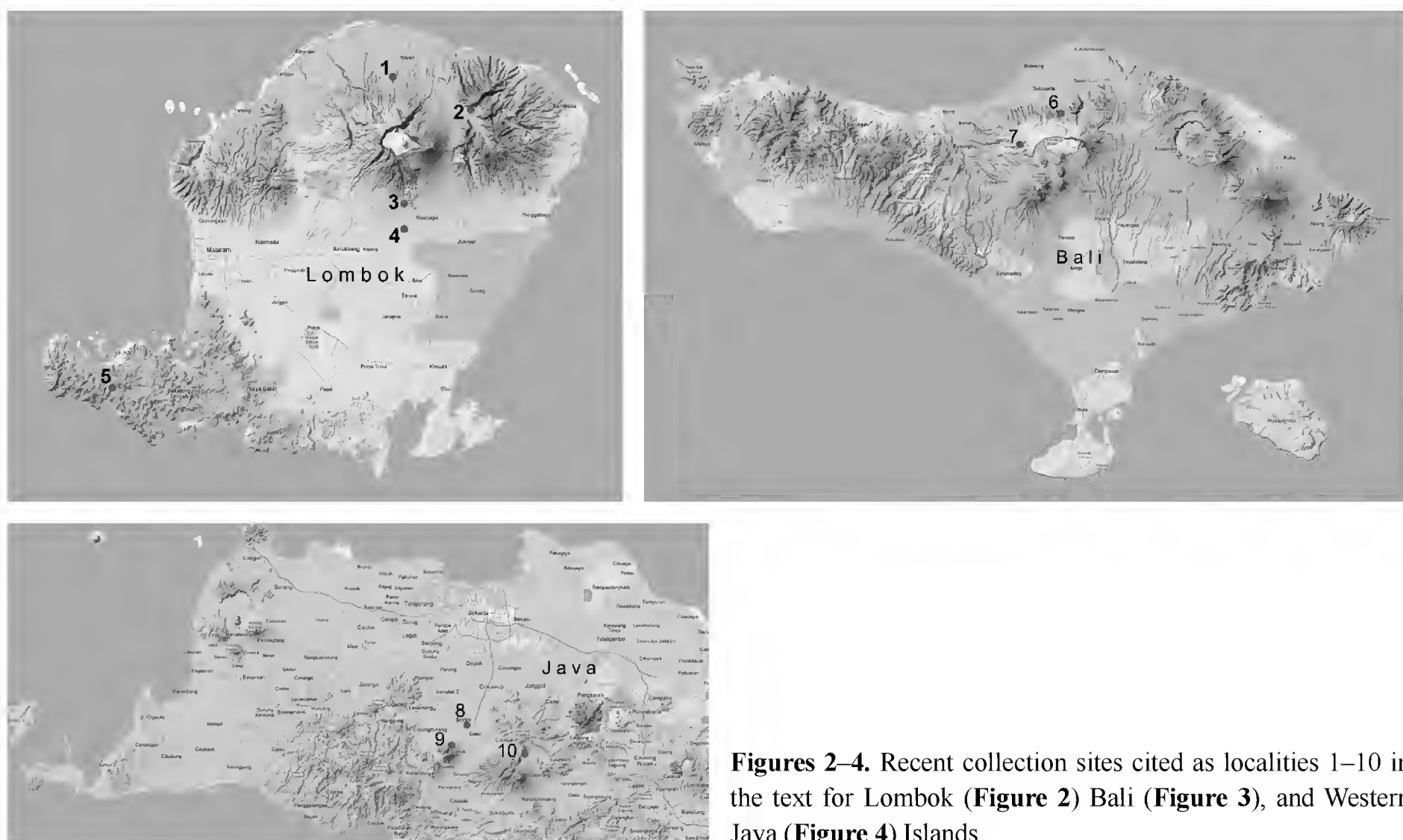
Collecting intensity plays a major role in the knowledge of a fauna. Of Thailand and (northern) Sumatra it is well known, of Western Java and Bali it is relatively well known, too. For Lombok, the results of the first visit are being presented here. Our experience shows that the first intensive collections in an unknown area may yield about 75% unknown species, followed by the second visit results constituting about 20%, while later the percentage of the new species decreases dramatically. We conclude that each of Bali and Lombok may have less than 100 species in total. Such a dramatic decrease of the species numbers from the continent to the islands is not a result of poor collections. Instead it is caused by the island impoverishment and remote position from the continent. The number of caddisfly species in an area of similar size in Thailand is three times larger than in Sumatra. Supposed extreme faunal richness of rainforests does not apply to the aquatic insects, like caddisflies, of this region. To compare with extratropical Central and Southern Europe: about 300 (Austria, Switzerland, Germany, European Russia) to 400 species (Italy, Turkey) are known from these countries.

The well-known Wallace's line which runs between Borneo and Bali on one side and Sulawesi and Lombok on the other side (Fig. 1) separates the Asiatic fauna from a mixed area. The latter is bounded from the East by the Lydekker line which runs between the Moluccas on one side and Australia and New Guinea on the other side. This means that Lombok belongs, according to this hypothesis, to the mixed area. According to the floras of this re-

gion, Lombok and surrounding islands are also separated (Van Welzen et al. 2011).

It is obvious that there is not an absolute border and the division is rather based on the deep sea waters between Bali and Lombok which remained deep even during the Pleistocene glaciations when the sea level was much lower (de Lattin 1967; Bănărescu 1995). Our data clearly show that there is no faunal gap between Bali and Lombok, as the faunas of these two islands are more or less the same (Tables 1, 2). Some families of Trichoptera have specific distribution patterns including both Asia and Australia (Mey 2001), and the northern part of Australia is faunistically similar to Asia (de Moor and Ivanov 2008). Some families of Asian origin migrated to Australia in the past and the Sunda Islands were probably the bridge for this migration.

Which Trichoptera species or groups may be considered to be the elements of Asiatic or Australian origin? Many families and genera have wide areas in the region, overlapping the borders of the continents (*Chimarra*, *Hydropsyche*, *Cheumatopsyche*, *Oecetis*). Some groups are important members of the Asiatic fauna, though they may be represented by very few species in Australia or New Guinea (*Agapetus*, *Tinodes*). On the other hand, very few groups typical for the Australian fauna are present in Asia, and the species numbers are low in each of these instances. The Australian Trichoptera have been studied for a long time with comprehensive data summarized by Neboiss (1986). Hydrobiosidae, a family rich in genera and species in Australia, is represented in Asia only by the genus *Apsilochorema* of which one species goes as far west as Iran, and relatively few species live on the mainland and on Sumatra and Borneo; none of them were found



**Figures 2–4.** Recent collection sites cited as localities 1–10 in the text for Lombok (**Figure 2**) Bali (**Figure 3**), and Western Java (**Figure 4**) Islands.

from Java to Lombok. The distribution of Hydrobiosidae emphasizes the separation of the Australian faunas from those of New Guinea and the Malay Archipelago. The Hydrobiosidae of New Guinea are represented by only 2 genera, *Apsilochorema* and related *Tanorus*, with 10 and 12 species, respectively. This family has numerous genera and species in Australia (62 sp.) and New Zealand (104 sp.), widespread in their non-tropical areas, and only 4 species of *Apsilochorema* are known from tropical north-east mountain ranges. The family Hydrobiosidae is known from the Mesozoic Taimyr ambers and the fossil beds of Transbaikalia and Mongolia (Botosaneanu and Wichard 1983; Ivanov and Sukatsheva 2002). Thus the presence of this family mostly on the south continents is a result of secondary proliferation of relics extinct in other regions (Eskov 1984). Similarly, the subfamily Triplectidinae is represented in the Eocene ambers of Europe (Ulmer 1912; Melnitsky and Ivanov 2010) by a few species related to the extant South Asian members of this subfamily. They are secondarily speciated in Australia though in Asia they are represented by only a few species of *Triplectides* and *Symphitoneuria* on the islands of Sumba, Sulawesi and Borneo, including one widespread species, found as far west as Pakistan and occurring also on Java, Bali and Lombok. Both groups, Hydrobiosidae and *Triplectides*, are incorrectly supposed to be of Gondwanian origin by Bănărescu (1990); this hypothesis is based on the recent (Holocene) faunistic data on their distribution and neglects the contradicting fossil data. Indeed the Baltic and Rovno Amber (Paleogene) and Taimyr Amber (Cretaceous) faunas were formed in times when no direct connection to Gondwana existed; the long lost links of Europe to the southern continents had been reestablished only in Oligocene after the times of amber deposition (Blakey 2008). Hence the fossil evidence from these ambers disproves the southern origin of the taxa in question. Thus it is self-evident that the caddisfly fauna of the western Sunda Islands including Lombok is predominantly of Asiatic origin, and influences from the Australian fauna were not found.

It is of highest zoogeographical interest to collect representative samples from the other Sunda Islands east of Lombok, and from the Moluccas. One may wonder that no such material is available in museums despite the intensive collecting activity of many other entomologists. The results of the faunal studies in Wallacea are also of high conservation importance. They can be used to steer both current and future efforts that try to preserve endemic flora and fauna of this uniquely diverse part of the biosphere.

## Conclusions

The caddisfly fauna of the islands of Java, Bali and Lombok is largely homogenous, and there is no gap or border between Bali and Lombok which would be expected from the hypothesis of Wallace's line. A continuous impoverishment of the caddisfly fauna from the Asiatic continent over the chain of islands is striking. This gradual impoverishment is observed in species number as well as in the numbers of genera or families. The Trichoptera fauna of the three islands is entirely Asiatic. There is no influence from the Australian fauna. The caddisflies of the Sunda Islands east of Lombok as well as those of the Moluccas are unknown, and their study is much required.

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## References

- Bănărescu P (1990) General distribution and dispersal of freshwater animals. Zoogeography of Fresh Waters. Vol. 1. Aula Verlag, Wiesbaden.
- Bănărescu P (1995) Distribution and dispersal of freshwater animals in Africa, Pacific areas and South America. Zoogeography of Fresh Water, Vol. 3. Aula Verlag, Wiesbaden.
- Blakey RC (2008) Gondwana paleogeography from assembly to break-up – a 500 million year odyssey. In: Fielding CR, Frank TD, Isbell JL (Eds) Resolving the Late Paleozoic Ice Age in Time and Space. Geological Society of America, Special Paper 441: 1–28. doi: 10.1130/2008.2441(01)
- Botosaneanu L, Wichard W (1983) Upper-Cretaceous Siberian and Canadian Amber Caddisflies (Insecta: Trichoptera). Bijdragen tot de Dierkunde 53: 187–217.
- Camerini JR (1993) Evolution, Biogeography, and Maps: An Early History of Wallace's Line. Isis 84 (4): 700–727. doi: 10.1086/356637
- Chantaramongkol P, Thapanya D, Bunlue P (2010) The Aquatic Insect Research Unit (AIRU) of Chiang Mai University, Thailand, with an updated list of the Trichoptera species of Thailand. Denisia 29: 55–79.
- de Lattin G (1967) Grundriß der Zoogeographie. Gustav Fischer Verlag, Stuttgart.
- de Moor FC, Ivanov VD (2008) Global diversity of caddisflies (Trichoptera: Insecta) in freshwater. Hydrobiologia 595 (1): 393–407. doi: 10.1007/s10750-007-9113-2
- Eskov KYu (1984) Continental drift and problems of the historical biogeography. Faunogenez i Philocenogenez. Nauka, Moscow, 24–92. [in Russian]
- Hall R (2009) SE Asia's changing palaeogeography. Blumea 54: 148–161. doi: 10.3767/000651909X475941
- Ivanov VD, Sukatsheva ID (2002) Order Trichoptera Kirby, 1813 – The Caddisflies. In: Rasnitsyn P, Quicke DLJ (Eds) History of Insects. Kluwer Academic Publishers, Dordrecht, 190–220.
- Malicky H (1995) Weitere neue Köcherfliegen (Trichoptera) aus Asien. Braueria 22: 11–26.
- Malicky H (1997) Ein Beitrag zur Kenntnis asiatischer Arten der Gattungen *Cheumatopsyche* Wallengren 1891 und *Potamyia* Banks 1900 (Trichoptera, Hydropsychidae). (Zugleich 22. Arbeit über thailändische Köcherfliegen). Linzer biologische Beiträge 29: 1015–1055.

- Malicky H, Chantaramongkol P (2000) Ein Beitrag zur Kenntnis asiatischer *Hydropsyche* – Arten (Trichoptera, Hydropsychidae). (Zugleich Arbeit Nr. 29 über thailändische Köcherfliegen). Linzer biologische Beiträge 32: 791–860.
- Malicky H (2002) Ein Beitrag zur Kenntnis asiatischer Arten der Gattung *Diplectrona* Westwood 1840 (Trichoptera, Hydropsychidae) (gleichzeitig Arbeit Nr. 34 über thailändische Köcherfliegen). – Linzer biologische Beiträge 34: 1201–1236.
- Malicky H (2004) Neue Köcherfliegen aus Europa und Asien. Braueria 31: 36–42.
- Malicky H (2005) Beiträge zur Kenntnis asiatischer *Oecetis* (Trichoptera, Leptoceridae). Linzer biologische Beiträge 37: 605–669.
- Malicky H (2006) Beiträge zur Kenntnis asiatischer Leptoceridae (Trichoptera: *Adicella*, *Athripsodes*, *Ceraclea*, *Leptocerus*, *Oecetis*, *Parasetodes*, *Tagalopsyche*, *Triaenodes*, *Trichosetodes*). – Linzer biologische Beiträge 38: 1507–1530.
- Malicky H, Chantaramongkol P (2006) Beiträge zur Kenntnis asiatischer *Setodes*-Arten (Trichoptera, Leptoceridae). Linzer biologische Beiträge 38: 1531–1589.
- Malicky H (2007) A survey of the Trichoptera of Sumatra. In: Bueno-Soria J, Barba-Alvarez R, Armitage B (Eds) Proceedings of the 12<sup>th</sup> International Symposium on Trichoptera, 175–179.
- Malicky H, Chantaramongkol P (2007) Beiträge zur Kenntnis asiatischer Hydroptilidae (Trichoptera). Linzer biologische Beiträge 39: 1009–1099.
- Malicky H (2008) Beschreibungen von neuen Trichopteren aus Asien. Braueria 35: 45–57.
- Malicky H (2009) Beiträge zur Kenntnis asiatischer Trichopteren. Braueria 36: 11–58.
- Malicky H (2010) Atlas of Southeast Asian Trichoptera. Faculty of Science Printing Unit, Chiang Mai University, Thailand.
- Malicky H, Ivanov VD, Melnitsky SI (2011) Beschreibungen von 27 neuen Köcherfliegen – Arten (Insecta, Trichoptera) von Lombok, Bali und Jawa (Indonesien), mit Kommentaren zu bekannten. Linzer biologische Beiträge 43 (2): 1491–1511.
- Melnitsky SI, Ivanov VD (2010) New Species of Caddisflies (Insecta: Trichoptera) from the Rovno Amber, Eocene of Ukraine. Paleontological Journal 44 (3): 303–311. doi: 10.1134/S003103011003010X
- Mey W (1998) The genus *Hydropsyche* Pictet, 1834 on islands in the East Pacific Region and descriptions of new species (Trichoptera: Hydropsychidae). Tijdschrift voor Entomologie 140: 191–205.
- Mey W (1999) Neue Arten der Familie Hydropsychidae (Insecta, Trichoptera) von Indonesien. Rudolstädter Naturhistorische Schriften, Supplement 3: 139–144.
- Mey W (2001) Australasian distributions in Trichoptera (Insecta) - a frequent pattern of a rare case? In: Metcalfe I, Smith JMB, Morwood M, Davidson I (Eds) Faunal and Floral Migrations and Evolution in SE Asia–Australasia. A.A. Balkema Publishers, Lisse, 255–268.
- Morse JC (1997) Checklist of World Trichoptera. In: Holzenthal RW, Flint OS Jr. (Eds) Proceedings of the 8th International Symposium on Trichoptera. Ohio Biological Survey, Columbus, Ohio, 339–342.
- Neboiss A (1986) Atlas of Trichoptera of the SW Pacific-Australian Region. Dr W. Junk, Dordrecht. doi: 10.1007/978-94-009-4814-3
- Schmid F (1970) Le genre *Rhyacophila* et la famille des Rhyacophilidae (Trichoptera). Memoires des Societe Entomologique de Canada 66: 1–230. doi: 10.4039/entm10266fv
- Schmid F (1984) Un essai d'évaluation de la faune mondiale des Trichopteres. In: Morse JC (Ed) Proceedings of the 4th International Symposium on Trichoptera. Dr. W. Junk Publishers, The Hague, The Netherlands, 337.
- Simpson GG (1977) Too many lines; the limits of the oriental and Australian Zoogeographic regions. Proceedings of the American Philosophical Society 121: 107–120.
- Ulmer G (1912) Die Trichopteren des Baltischen Bernsteins. Beiträge zur Naturkunde Preussen 10: 1–380.
- Ulmer G (1951) Köcherfliegen (Trichopteren) von den Sunda-Inseln (Teil 1). Archiv für Hydrobiologie, Supplement 19: 1–528.
- Ulmer G (1955) Köcherfliegen (Trichopteren) von den Sunda-Inseln (Teil 2). Archiv für Hydrobiologie, Supplement 21: 408–608.
- Ulmer G (1957) Köcherfliegen (Trichopteren) von den Sunda-Inseln (Teil 3). Archiv für Hydrobiologie, Supplement 23: 109–470.
- Van Welzen PC, Parnell JAN, Slik JWF (2011) Wallace's Line and plant distributions: two or three phytogeographical areas and where to group Java? Biological Journal of the Linnean Society 103: 531–545. doi: 10.1111/j.1095-8312.2011.01647.x
- Wells A (1993) Micro-caddisflies (Trichoptera: Hydroptilidae) from Bali, Indonesia. Zoologische Mededelingen 67: 351–359.
- Wells A, Malicky H (1997) The micro-caddisflies of Sumatra and Java (Trichoptera: Hydroptilidae). Linzer Biologische Beiträge 29: 173–202.

# Revisional notes on the genus *Melucha* (Hemiptera, Heteroptera, Coreidae)

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## Abstract

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*Melucha grandicula* **sp. n.** and *M. perampla* **sp. n.**, (Hemiptera: Heteroptera: Coreidae: Coreinae: Nematopodini) are described from Bolivia, Colombia, Paraguay and Peru. *Melucha quadrivittis* Stål, 1862, **stat. restit.**, is resurrected from synonymy under *M. phyllocnemis* (Burmeister, 1835). *Melucha ruficornis* Breddin, 1903, **syn. n.**, is synonymized under *M. lineatella* (Fabricius, 1803). An identification key for the known species of *Melucha* Amyot & Serville, 1843 is given. New distributional records for some previously known species are added.

## Key Words

Insecta  
Hemiptera  
Heteroptera  
Coreidae  
Nematopodini  
*Melucha*  
new species  
new synonym  
Neotropical

## Introduction

The genus *Melucha* Amyot & Serville, 1843, is distributed in Mexico, Central America (Guatemala, Costa Rica) and South America (Colombia, French Guiana, Brazil, Paraguay, Bolivia, Peru). It belongs to the tribe Nematopodini of the family Coreidae and is characterized by having: postocular tubercles not evident, forming a smooth curve with eye; antenniferous tubercles wide, not projecting far anteriorly; tylus projecting anteriorly of antenniferous tubercle; antennal segment I longer than length of head, thicker than following segments and

curved; segment II cylindrical, III cylindrical or dilated, and IV fusiform; anterolateral and posterolateral borders of pronotal disk smooth or conspicuously nodulose and spinate; mesosternum lacking sulcation; and abdominal spiracles rather large, transversely elliptical, situated nearer to anterior than to lateral margins (O'Shea 1980).

The genus currently includes 11 species considered as valid: *M. aculeata* Montandon, 1895, *M. acutispina* Breddin, 1903, *M. bicolor* Distant, 1892, *M. biolleyi* Distant, 1900, *M. chapadana* Brailovsky, 1993, *M. dilatata* (Fabricius, 1798), *M. gladiator* (Fabricius, 1803), *M. lineatella* (Fabricius, 1803), *M. phyllocnemis* (Bur-



meister, 1835), *M. quinquelineata* Stål, 1865, and *M. ruficornis* Breddin, 1903 (Brailovsky 1993, Packauskas 2010). In this contribution, *M. quadrivittis* Stål, 1862, is resurrected from synonymy under *M. phyllocnemis* and considered a valid species; *M. ruficornis* Breddin, 1903 is synonymized under *M. lineatella* (Fabricius). Two new species, *M. grandicula* sp. n. and *M. perampla* sp. n., are described from Bolivia, Colombia, Paraguay and Peru. New distributional records for *M. phyllocnemis* and *M. quadrivittis* are added. With these additions and changes the number of known species of *Melucha* is fixed in 13. A key to separate all the species of the genus is presented.

## Material and methods

The following collection acronyms are used for the institutions cited in this paper:

- AMNH American Museum of Natural History, New York, USA;  
 CDFA California State Collection of Arthropods, Sacramento, California, USA;  
 DEIC Deutsches Entomologisches Institut, München, Germany;  
 INBIO Instituto Nacional de Biodiversidad, Santo Domingo de Heredia, Costa Rica;  
 MABR Museo Argentino de Ciencias Naturales “Bernardino Rivadavia”, Buenos Aires, Argentina;  
 MELN Museo Entomológico, Leon, Nicaragua;  
 NHMW Naturhistorisches Museum, Wien, Austria;  
 NHRS Naturhistoriska Riksmuseet, Stockholm, Sweden;  
 TAMU Texas A & M University, College Station, Texas, USA;  
 UGAG University of Georgia, Athens, Georgia, USA;  
 UMSP University of Minnesota, Insect Collection, USA;  
 UNAM Instituto de Biología, Universidad Nacional Autónoma de México;  
 USNM Smithsonian Institution, National Museum of Natural History, Washington, DC, USA;  
 ZMUH Zoologisches Museum, Universität Hamburg, Hamburg, Germany.

All measurements are given in millimeters.

## Results

### *Melucha grandicula* sp. n.

<http://zoobank.org/3A82C0B5-2929-44C9-A97B-F5846317BFEC>

[http://species-id.net/wiki/Melucha\\_grandicula](http://species-id.net/wiki/Melucha_grandicula)

Fig. 11.

**Type material.** Holotype, female, Peru, Loreto, Headwaters, Río Loreto-Yacu, Indian Vill., 21-IV-1-V-1970, Malkin (AMNH). Paratypes, 1 female, Colombia, Meta, El Buque, silv., 1200 m, 18-II-1947 (NHMW); 1 female, Colombia, without date (UNAM).

**Description** (female, holotype). **Dorsal color.** Head and antennal segments I to III shiny orange, segment IV pale yellowish orange; pronotum coarsely punctate, strongly striate, reddish brown, with a single, longitudinal, median dark line, diffuse, with pigment in the punctures; scutellum reddish brown with basal third, lateral borders and apex shiny orange; clavus and corium finely punctate, reddish brown, moderately infusate; hemelytral membrane amber, translucent, veins darker; connexival segments reddish brown with posterior spines black; dorsal abdominal segments dark orange with irregular dark marks.

**Ventral color.** Rostral segments (apex of IV dark brown), legs, and anterior and posterior lobe of metathoracic scent gland peritreme shiny to dull orange; pro- and mesopleura coarsely punctate with black elongate mark; hind femur dull orange with dorsal and ventral tubercles and spines black; hind tibiae dark orange with posterior third yellowish orange; middle and hind tarsus yellowish orange.

**Structure.** Body large-sized (above 22.00 mm), robust, almost glabrous.

**Head.** Antennal segment III cylindrical; rostrum reaching anterior margin of mesosternum.

**Thorax.** Pronotal disk declivent; anterolateral borders obliquely straight, nodulose, armed with five or six subacute spines; humeral angles prominent, laterally expanded, apically sharply pointed; posterolateral borders almost straight, nodulose, with three or four subacute spines; posterior border smooth, straight; callar region evident.

**Legs.** Fore and middle femora not incrassate; dorsal surface smooth, ventral surface distally armed; hind femur incrassate its dorsal surface with two rows of tubercles, ventral surface armed with two rows of spines increasing in size distally; fore and middle tibiae sub-cylindrical, unarmed, sulcate; inner and outer surfaces of hind tibiae markedly dilated; outer surface smooth, inner surface with short tubercles on the border.

**Scutellum.** Triangular, wider than long, transversely striate and punctate; apex subacute.

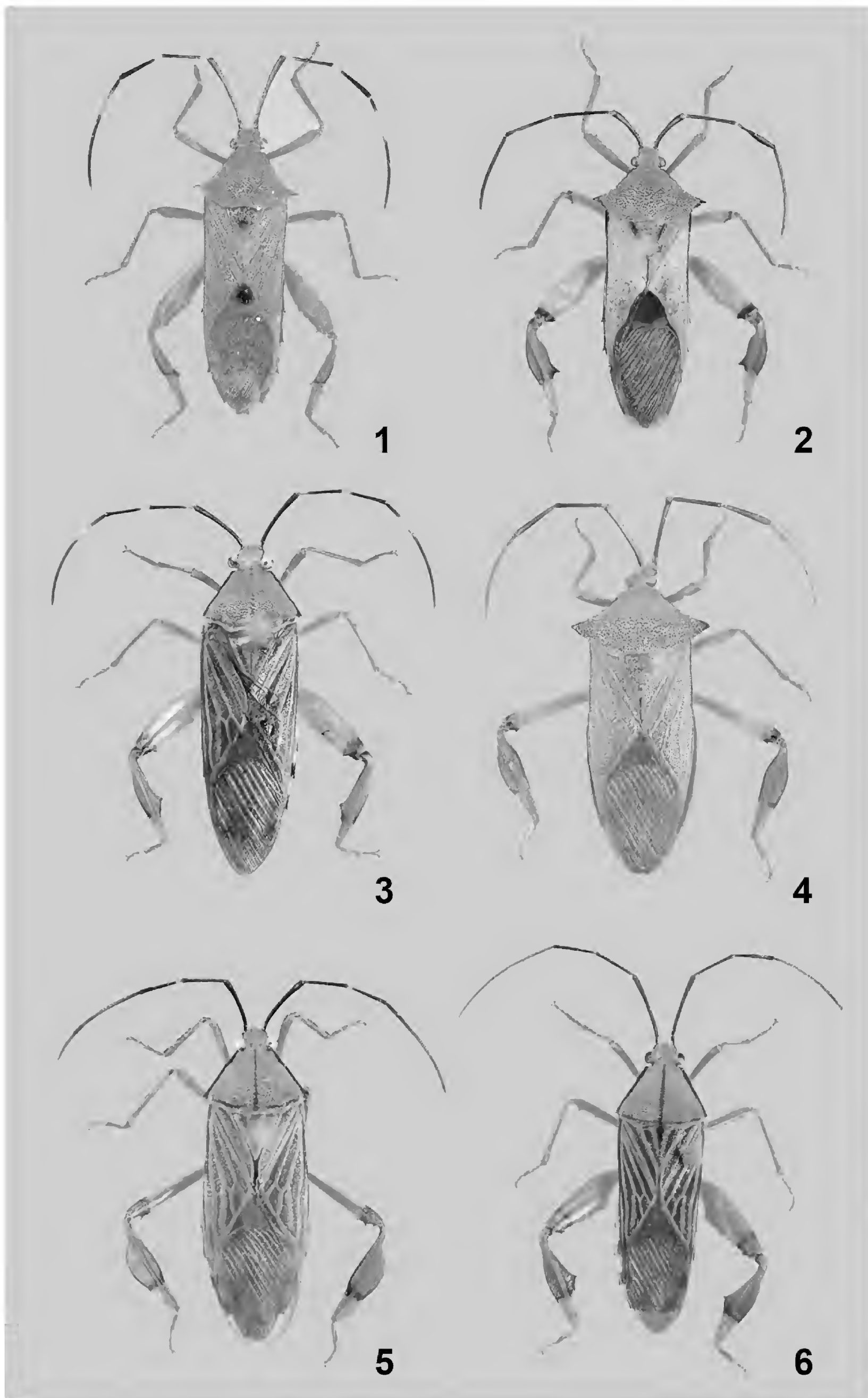
**Abdomen.** Posterior angle of abdominal segments III to VI armed with short but distinct spine.

**Male.** Unknown.

**Measurements** (holotype; mm). Total body length 27.50. Head length 2.28; width across eyes 2.98; interocular space 1.74; interocellar space 0.92; preocular distance 1.61; length of antennal segments: I, 6.15; II, 4.25; III, 3.80; IV, 7.60. Pronotal length 6.53; width across humeral angles 11.78. Scutellar length 3.19; width 3.57. Maximum width of abdomen 9.70.

**Differential diagnosis.** This species is closely related to *M. phyllocnemis* and *M. quadrivittis*, which are also robust and larger than 23.00 mm; the other species in the genus are slender and shorter than 20.00 mm.

*Melucha grandicula* sp. n. is distinguished by having a single median dark line on the pronotal disk, the humeral angles prominent, laterally expanded, and apically sharply pointed (Fig. 11) and connexival segment VII en-



**Figures 1–6.** Dorsal view of *Melucha* spp. **1**, *M. aculeata* Montandon, 1895 (male). **2**, *M. biolleyi* Distant, 1900 (male). **3**, *M. dilatata* (Fabricius, 1798) (male). **4**, *M. acutispina* Breddin, 1903 (female). **5**, *M. chapadana* Brailovsky, 1993 (female). **6**, *M. lineatella* (Fabricius, 1798) (male).

tirely dark orange. In the other two species the pronotal disk is yellow and has four longitudinal dark lines and the midline unpigmented, the humeral angles prominent, laterally expanded, and apically blunt (Figs. 8, 9) and connexival segment VII is yellow, with posterior half or posterior third dark brown.

**Etymology.** Named for the comparatively large size of this species, after the Latin adjective “*grandiculus*, -a, -um” meaning rather large.

**Distribution.** Known from Colombia and Peru.

### *Melucha perampla* sp. n.

<http://zoobank.org/7FF2B7CC-BBA3-48A7-A251-894AE1C92AE8>

[http://species-id.net/wiki/Melucha\\_perampla](http://species-id.net/wiki/Melucha_perampla)

Fig. 12.

**Type material.** Holotype: female, Bolivia, Departamento La Paz, Prov. Sud-Yungas, Puente Villa, 4300', 19-24-V-1989, J. E. Eger (UNAM). Paratypes: 1 female, Paraguay, Cororo, X-1979, M. Viana (UNAM); 3 females, Departamento San Pedro, Cororo, Rio Ypane, 12-XI-1983, G. J. Williner (UNAM).

**Description** (female, holotype). **Dorsal color.** Head yellow; preocular area and two short, diffuse stripes laterally to midline pale brown; antennal segments I to III black, IV yellow; pronotum finely punctate, yellow, pronotal disk with four longitudinal dark brown lines with pigment in the punctures and midline unpigmented; anterolateral spines of pronotum reddish brown; scutellar disk yellow with punctures reddish brown; clavus and corium dark yellow with punctures reddish brown; hemelytral membrane dark amber, veins brown and darker; connexival segments III to V dark brown with anterior third yellow, VI–VII with anterior half yellow and posterior half dark brown, and VIII–IX yellowish orange; upper border of connexivum anteriorly yellow and posteriorly black; posterolateral spines black; dorsal abdominal segments dark yellow with irregular dark brown marks.

**Ventral color.** Rostral segments (apex of IV dark brown), legs, anterior and posterior lobe of metathoracic scent gland peritreme and abdominal sterna yellow; hind femur yellow with ventral spines and apical border reddish brown to black; hind tibia yellowish orange, posterior third yellow with dark reddish brown transverse mark near posterior third.

**Structure.** Body large-sized (above 22.00 mm), robust, almost glabrous.

**Head.** Antennal segment III dilated; rostrum reaching anterior margin of mesosternum.

**Thorax.** Pronotal disk declivent; anterolateral borders obliquely straight, armed with 15 or more acute spines; humeral angles prominent, laterally expanded and apically blunt; posterolateral borders nodulose with three or four subacute spines; posterior border smooth, straight; callar region evident.

**Legs.** Fore and middle femora not incrassate their dorsal surface smooth, ventral surface distally armed; hind

femur incrassate its dorsal surface smooth, ventral surface armed with two rows of spines increasing in size distally; fore and middle tibiae sub-cylindrical, unarmed, sulcate; inner and outer surface of hind tibiae markedly dilated; outer surface smooth, inner surface with short tubercles on the border.

**Scutellum.** Triangular, longer than wide, transversely striate, punctate; apex subacute.

**Abdomen.** Posterior angle of abdominal segments III to VII armed with short but distinct spine.

**Male.** Unknown.

**Measurements** (holotype; mm). Total body length 25.75. Head length 1.90; width across eyes 2.59; interocular space 1.55; interocellar space 0.77; preocular distance 1.38; length of antennal segments: I, 5.77; II, 4.10; III, 4.25; IV, 6.84. Pronotal length 5.74; width across humeral angles 8.76. Scutellar length 3.66; width 3.37. Maximum width of abdomen 9.73.

**Differential diagnosis.** Like *M. phyllocnemis* and *M. quadrivittis*, the humeral angles of *M. perampla* sp. nov., are prominent, laterally expanded and apically blunt; the pronotal disk has four longitudinal dark brown lines with the midline unpigmented; total body length over 20 mm. *Melucha perampla* differs by having the antennal segments I to III black, antennal segment III clearly dilated at inner and outer faces and mesopleura and metapleura without black marks. In the other two species the antennal segments I to III are yellowish orange, antennal segment III is almost cylindrical, not dilated and mesopleura and metapleura have reddish brown to black elongate marks. The dorsal surface of the hind femur of *M. quadrivittis* is armed with two rows of black nodules and tubercles (Fig. 8) while in *M. phyllocnemis* and *M. perampla* those are smooth (Figs. 9, 12).

**Etymology.** Named for the large size of this species, after the Latin adjective “*peramplus*, -a, -um”, meaning very large.

**Distribution.** Known from Bolivia and Paraguay.

### *Melucha lineatella* (Fabricius, 1803)

[http://species-id.net/wiki/Melucha\\_grandicula](http://species-id.net/wiki/Melucha_grandicula)

Fig. 6.

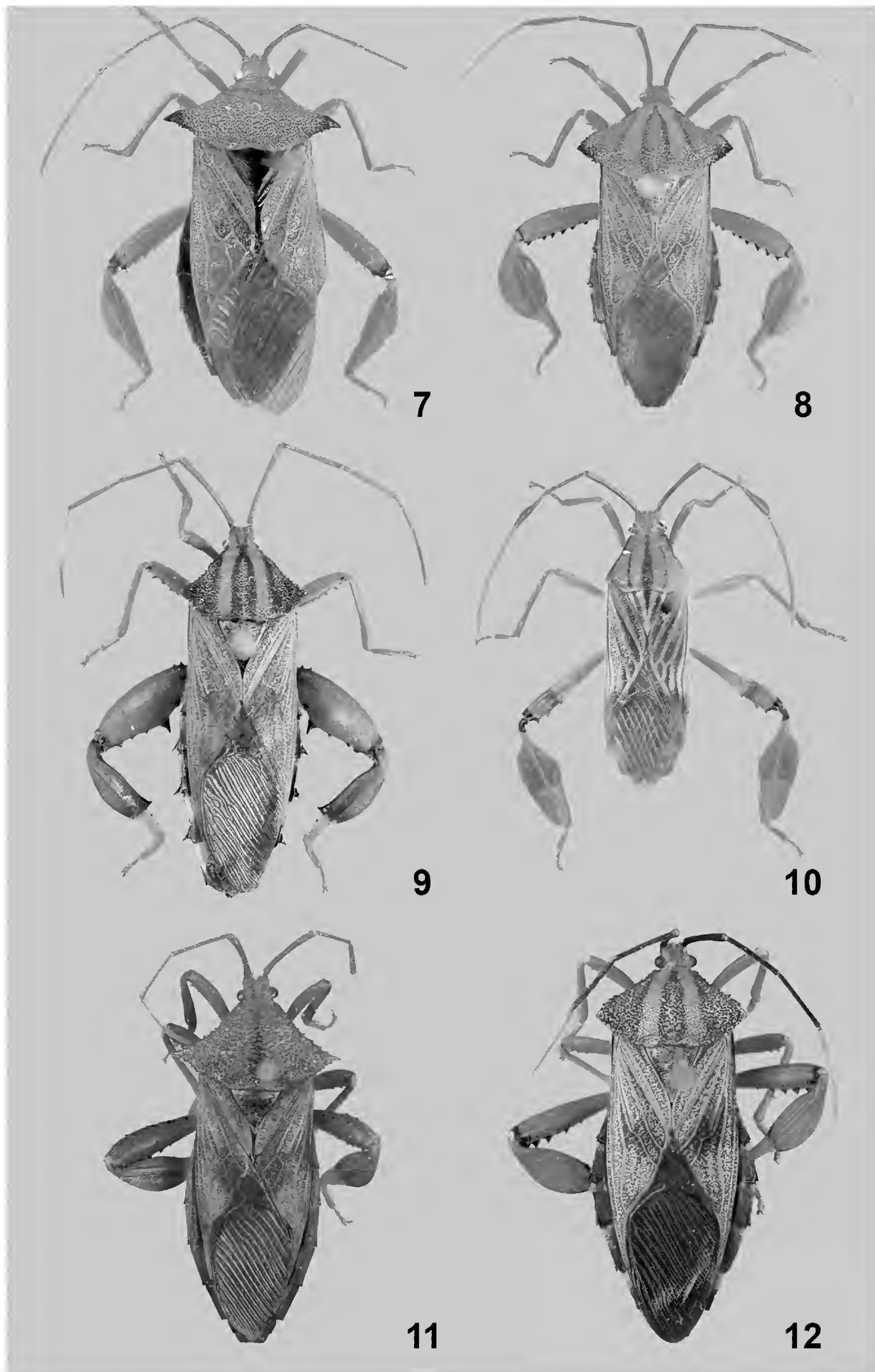
*Lygaeus lineatellus* Fabricius, 1803: 216.

*Melucha ruficornis* Breddin, 1903: 379-380, **syn. n.**

**Type material examined.** *Melucha ruficornis*: female, Bolivia, La Paz, Yungas (DEIC).

**Taxonomy.** *Melucha ruficornis* Breddin, 1903, was described based on a single female from Bolivia and here is considered a junior synonym of *M. lineatella* (Fabricius, 1803). The holotype of *M. ruficornis* was examined and compared with several specimens of *Melucha lineatella*. The features considered by Breddin as diagnostic characters like the total length of the body, the shape of the humeral angles, and the color of antennal segments, pronotal disk and hind femora are shared with *M. lineatella* and this reinforces the proposed synonymy.





**Figures 7–12.** Dorsal view of *Melucha* spp. 7, *M. gladiator* (Fabricius, 1803) (female). 8, *M. quadrivittis* Stål, 1862 (female). 9, *M. phyllocnemis* (Burmeister, 1835) (male). 10, *M. quinquelineata* Stål, 1865 (male). 11, *M. grandicula* sp. n. (female). 12, *M. perampla* sp. n. (female).

***Melucha phyllocnemis* (Burmeister, 1835)**

[http://species-id.net/wiki/Melucha\\_phyllocnemis](http://species-id.net/wiki/Melucha_phyllocnemis)

Fig. 9.

*Cerbus phyllocnemis* Burmeister, 1835: 340.

**Distribution.** Bolivia: Coroico Yungas. Brazil: Sao Paulo, Rio de Janeiro, Rio Grande do Sul. Colombia: Nova Granada (Stål 1870). Paraguay (Stål 1870, Blöte 1938, Osborn 1904, Packauskas 2010).

**Material examined. New records. Argentina:** 2 males, Misiones, Posadas, VII-1972, D. Carpintero (UNAM); 3 females, Misiones, Iguazu, III-1954, III-1981, 14-XI-1981, A. Martinez, R. Foerster (MABR, UNAM); 1 male, Entre Rios, I-1974, Zelich (UNAM); 1 male, Formosa Estancia, Guaycolec, 25 km N Formosa, 185 m, 26-II-10-III-1999, S. L. Heydon, J. Ledford (UCDC). **Brazil:** 1 female, Espiritu Santo, Santa Teresa, 18-23-XII-1967, C. Elias (UNAM); 1 female, Nova Teutonia, 17-XII-1935, F. Plaumann (USNM). **Paraguay:** 1 male, District Villarrica, Mbebo, XI-1926, P. Jorgensen (ZMUH); 1 female, San Pedro, General Resquin, Naranjito, 1-I-1994, B. Garcete (MELN); 1 female, Depto. San Pedro, Coroño, Rio Ypane, 12-XI-1983, G. Willner (CDFA); 1 male, Depto. San Pedro, Coroño, 1-30-X-1979, G. J. Willner (CDFA).

***Melucha quadrivittis* Stål, 1862**

[http://species-id.net/wiki/Melucha\\_quadrivittis](http://species-id.net/wiki/Melucha_quadrivittis)

Fig. 8.

*Melucha quadrivittis* Stål, 1862: 276, **stat. restit.**

*Melucha quadrivittis*: Stål, 1870: 133 (synonymized with *M. phyllocnemis*)

**Type material examined.** *Melucha quadrivittis*: male (NHRS).

**Distribution.** Mexico, Oaxaca, Veracruz, Atoyac and Orizaba (Stål 1862, Walker 1871, Distant 1893, Packauskas 2010).

**Material examined. New records. Belize:** 1 female, Grano de Oro, Chiquibul Forest Reserve, 4-7-IV-1995, T. King, A. Howe (UNAM). **Costa Rica:** 4 males, 4 females, Provincia Guanacaste, estacion Las pailas, P. N. Rincon de la Vieja, 800 m, 27-VII-12-X-1992, 15-V-11-VI-1993, 8-26-V-1994, C. Cano, D. Garcia, K. E. Taylor (INBIO); 3 males, 3 females, Provincia Guanacaste, Estacion Santa Rosa, P. N. Santa Rosa, 300 m, VIII-1980, VII-1989, II-1992, (without collector) (INBIO); 5 females, Provincia Puntarenas, Fca. Cafrosa, Estacion Las Mellizas, P. N. Amistad, 1300 m, X-1989, 7-XII-1989, 17-I-1990, M. Ramirez, G. Mora (INBIO). **Honduras:** 1 male, Liberia, 6-IX-1984, C. W. O'Brien (UNAM); 1 female, Olancho, La Murala, 24-V-1995, R. Morris (UGAG); 1 male, Copan, 19 km SW Santa Rosa de Copan, 8-X-1993, R. Turnbow (UGAG); 1 female, Cedros, Francisco Morazan, 2-XII-1976 (UMSP). **Mexico:** 1 female, Campeche, 6 mi N de

Xpujil, Chicana Ruins, 27-VII-1980, Schaffner, Weaber (TAMU); 1 male, 13.8 mi E Escarcega, 26-27-VII-1980, Schaffner, Weaber (TAMU). 1 female, Chiapas, 2 mi E Rizo de Oro, 2900', 1-VIII-1974, C. W. and L. O'Brien and Marshall (UNAM); 2 males, Chiapas, Municipio de Ocozocoautla, Reserva El Ocote, 2 km de A. Obregon, 14-IV-1994, O. Gomez (UNAM); 1 female, Chiapas, Bonampak, 21-V-1980, J. Bueno (UNAM); 1 female, Chiapas, Reserva El Ocote, 2-10-XII-1993, G. Ortega-Leon, E. Barrera and A. Casasola (UNAM); 1 male, Chiapas, Villa Corzo, 2-XI-1983, J. Morales (UNAM); 1 male, Nuevo Leon, Guadalupe, X-1980, A. Ortiz (UNAM); 2 females, Nuevo Leon, Rayones, 17-IV-1974, Patton (UNAM); 1 female, Oaxaca, Tuxtepec, 24-IX-1947 (UNAM); 1 male, Oaxaca, 2 mi N Candelaria Loxicha, 17-VII-1974, Clark, Schaffner (TAMU); 2 males, 1 female, Quintana Roo, X-Can Nuevo, 17-IX-1983, E. Welling (UNAM); 1 female, Quintana Roo, 8 mi N Felipe Carrillo Puerto, 1-VII-1970, R. E. Beer (UNAM); 1 female, Quintana Roo, 26 km SE Valle Hermoso, 22-VI-1989, A. Cadena, L. Cervantes (UNAM); 1 male, Quintana Roo, 3-VIII-1981, E. Pech (UNAM); 1 female, Quintana Roo, 2 km NE El Ramonal, 10-IX-1983, O. Canul (UNAM); 1 female, Quintana Roo, Puerto Morelos, 11-VIII-1982, V. Hernandez (UNAM); 1 female, San Luis Potosi, El Salto, IX-1959, D. Pelaez (UNAM). 1 male, Tabasco, Campo Experimental CSAT, Cardenas, 13-IX-1976, J. Rivera (UNAM). 1 male, 1 female, Tamaulipas, Ciudad Victoria, 17-XI-1977, H. Brailovsky (UNAM); 1 male, Tamaulipas, Tula, km 20 Tula-Ocampo, Colonia Guadalupe, 446 m, 22°53'13"N-99°28'34"W, 12-V-2007, H. Brailovsky, E. Barrera and L. Cervantes-Peredo (UNAM). 7 males, 7 females, Veracruz, Estación de Biología Tropical Los Tuxtlas, III-1978, 20-XII-1984, 25-VIII-1998, 27-X-4-XI-1988, 15-27-VI-1989, 21-VII-1989, 6-IX-1989, 30-X-2007, H. Brailovsky, E. Gonzalez, E. Mejorada, H. Rojas, J. L. Colin and R. Mariño (UNAM). **Nicaragua:** 1 male, Chinaniloga, Volcan Casita, 10-VI-1985, Maes, Jolivet (MELN); 1 female, Matagalpa, Selva Negra, 1375 m, 28-XII-1991, A. E. Mahler (UNAM). **Panama:** 1 male, Chiriqui, Chiriquicito, 16-V-1996, R. Turnbow (UGAG); 1 male, Panama Prov., Cerro Campana, 11-IX-1998, Gillogly, Stockwell (TAMU).

**Taxonomy.** Burmeister (1835) described *M. phyllocnemis* from Brazil, and Stål (1862) *M. quadrivittis* from Mexico. Dallas (1852) recorded *M. phyllocnemis* from Colombia and years later Stål (1870) synonymized *M. quadrivittis* under *M. phyllocnemis* and recorded this species from Mexico, Colombia (Nova Granada), Brazil and Paraguay. Packauskas (2010) summarized the known information and cited *M. phyllocnemis* s. lato from Bolivia, Brazil, Mexico, Colombia and Paraguay. The type material of *M. quadrivittis* was examined and compared with the original description of *M. phyllocnemis*, as well as with more than 110 specimens. Two different species were clearly recognized, therefore *M. quadrivittis* was resurrected here as valid species.

Both species share the following characters: total body length over 23.00 mm; anterolateral borders of pronotum coarsely serrate; pronotal disk yellow with four longitudinal dark lines; the humeral angles prominent, laterally expanded; and antennal segments II and III pale orange to yellowish orange.

In *M. quadrivittis* the dorsal surface of hind femur is armed with two rows of black nodules and tubercles; it is distributed from Mexico to Panama (Fig. 8). In *M. phyllocnemis* the dorsal surface of hind femur is smooth. It is distributed from Colombia to Paraguay, including Bolivia and Brazil (Fig. 9).

### Key to the known species of *Melucha* Amyot & Serville, 1843

- 1 Anterolateral borders of pronotum very coarsely serrate; total length of body longer than 23.00 mm..... 2
- Anterolateral borders of pronotum smooth or finely serrate; total length of body shorter than 20.00 mm ..... 6
- 2 Antennal segments II and III dark reddish-brown to black ..... 3
- Antennal segments II and III pale orange to pale yellowish orange..... 4
- 3 Pronotal disk dark reddish-brown; dorsal surface of hind femora dark reddish-brown and ventral surface dull orange..  
..... *M. bicolor* Distant, 1892
- Pronotal disk yellow with four longitudinal dark brown lines; hind femora yellow with ventral spines black (Fig. 12).....  
..... *M. perampla* sp. n.
- 4 Pronotal disk reddish-brown, with a single longitudinal median dark line; humeral angles of pronotum prominent, laterally expanded, and apically sharply pointed (Fig. 11).....*M. grandicula* sp. n.
- Pronotal disk yellow with four longitudinal dark lines; humeral angles of pronotum prominent, laterally expanded, and apically blunt to nodulose..... 5
- 5 Dorsal surface of hind femur armed with two rows of black nodules and tubercles (Fig. 8) ..... *M. quadrivittis* Stål, 1862
- Dorsal surface of hind femur smooth (Fig. 9).....  
.....*M. phyllocnemis* (Burmeister, 1835)
- 6 Anterolateral borders of pronotum uniformly crenulate; humeral angles laterally expanded, apically sharply pointed.. 7
- Anterolateral borders of pronotum smooth; humeral angles obtuse, not exposed, with or without short spine directed backward ..... 10
- 7 Antennal segments I to III entirely shiny orange; anterolateral borders of pronotum shiny orange (Fig. 7).....  
..... *M. gladiator* (Fabricius, 1803)
- Antennal segments I to III predominantly or entirely black or dark reddish brown; anterolateral borders of pronotum black..... 8
- 8 Antennal segment IV dark brown with basal third (except basal joint) yellow (Fig. 1) .....*M. aculeata* Montandon, 1895
- Antennal segment IV entirely dark brown to black..... 9
- 9 Hemelytral membrane brassy with basal third black; antennal segment III bicolorous (Fig. 2) ..*M. biolleyi* Distant, 1900
- Hemelytral membrane uniformly brassy, without black spot basally; antennal segment III entirely black (Fig. 4) .....  
..... *M. acutispina* Breddin, 1903
- 10 Antennal segment IV dark brown with basal third (except basal joint) yellow (Fig. 3) .....*M. dilatata* (Fabricius, 1798)
- Antennal segment IV entirely dark brown or dark reddish brown or shiny reddish orange ..... 11
- 11 Antennal segments I to III shiny orange to shiny reddish brown; pronotal disk shiny yellow with three black to reddish-brown longitudinal stripes (Fig. 10) .....*M. quinquelineata* Stål, 1865
- Antennal segments I to III never shiny orange; pronotal disk yellow with one black to reddish brown longitudinal stripe running mesially..... 12
- 12 Antennal segments II and III reddish-brown with basal joint yellow (Fig. 5).....  
.....*M. chapadana* Brailovsky, 1993
- Antennal segments II and III entirely reddish-brown (Fig. 6).....*M. lineatella* (Fabricius, 1798)

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### References

- Amyot CJB, Serville A (1843) Histoire naturelle des insectes. Hémiptères. In: “Studies à Buffon.” Fain at Thunot. Paris. LXXVI, 675 pp.
- Blöte HC (1938) Catalogue of the Coreidae in the Rijksmuseum van Natuurlijke Histoire. Part IV. Coreinae, third part. Zoologische Mededeelingen 20: 75–308.
- Brailovsky H (1993) Género nuevo y especies nuevas de coreidos neotropicales (Hemiptera-Heteroptera-Coreidae: Acanthocerini, Chari-

- esterini, Coreini, Discogastrini, Leptoscelidini y Nematopodini). *Anales del Instituto de Biología, Universidad Nacional Autónoma de México, Serie Zoología* 64(2): 109–127.
- Bredden G (1903) Beiträge zur Hemipteran fauna der Anden. Sitzungberichte der Gesellschaft Naturforschender Freunde zu Berlin 8: 366–383.
- Burmeister H (1835) *Handbuch der Entomologie. Zweiter Band. Besondere Entomologie. I. Ordnung. Rhynchota. T. Enslin., Berlin, Abtheil I*, 400 pp.
- Distant WL (1881–1893) *Insecta Rhynchota. Hemiptera-Heteroptera. Vol. I. III. Biologia Centrali-Americana*, London, 462 pp.
- Fabricius JC (1803) *Systema Rhyngotorum secundum ordines, genera, species, adjectis synonymis, locis, observationibus, descriptionibus*. Apud Carolum Reichard, Brunsvigae, 314 pp. doi: 10.5962/bhl.title.11644
- Osborn H (1904) Notes on South American Hemiptera-Heteroptera. *Ohio Naturalist* 5: 195–204
- O’Shea R (1980) A generic revision of the Nematopodini (Heteroptera: Coreidae: Coreinae). *Studies on Neotropical Fauna and Environment* 15: 197–225. doi: 10.1080/01650528009360574
- Packauskas R (2010) Catalog of the Coreidae, or leaf-footed bugs of the New World. *Fort Hays Studies, Fourth Series*, 5: 1–270.
- Stål C (1862) Hemiptera mexicana enumeravit speciesque novas descripsit. *Stettin Entomologische Zeitung* 23(4–6): 273–281.
- Stål C (1870) *Enumeratio Hemipterorum. Kongliga Svenska Vetenskaps-Akademiens Förhandlingar*, part 1, 9: 1–232.
- Walker F (1871) *Catalogue of the specimens of Hemiptera-Heteroptera in the collection of the British Museum, Part 4*, London: 1–211.
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# A new species of *Sinophasma* Günther, 1940 from Guangxi, China (Phasmida: Diapheromeridae: Necrosciinae)

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† <http://zoobank.org/3173965C-4FAA-4DE4-9E2D-3CDD92945216>

<http://zoobank.org/A402A988-4127-474C-BFBE-A3BA80E4DDA1>

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## Abstract

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This article describes one new species, *Sinophasma damingshanensis* sp. n. from Guangxi, China.

Academic editor:

Susanne Randolph

## Key Words

Stick Insects

Necrosciini

Taxonomy

Damingshan

Mainland China

Oriental Region

## Introduction

The genus *Sinophasma* Günther, 1940 is mainly distributed over China and Taiwan (Shiraki 1935; Otte and Brock 2005; Hennemann et al. 2008; Chen and He 2008; Ho 2012; Huang 2013). *S. vietnamense* Chen & Chen, 1999 from North Vietnam is the only species known from outside China and Taiwan. Currently twenty-six species and two subspecies are recognized in this Palearctic and Oriental genus. The major revisionary work was provided by Chen and He (2008) and a revised key was provided by Ho (2012). The author recently conducted a collecting trip to Damingshan, located at the south-central Guangxi, China, and discovered a new species, *S. damingshanensis* sp. n., described and illustrated in this study.

## Material and methods

The specimen was collected directly by hand at night due to their nocturnal behavior. A hand torch was used to spot them on the plants. The type specimens of *Sinophasma damingshanensis* sp. n. are deposited in Hong Kong Entomological Society (HKES). Morphological terms largely follow Bragg (2001) and Zompro (2004).

## Results

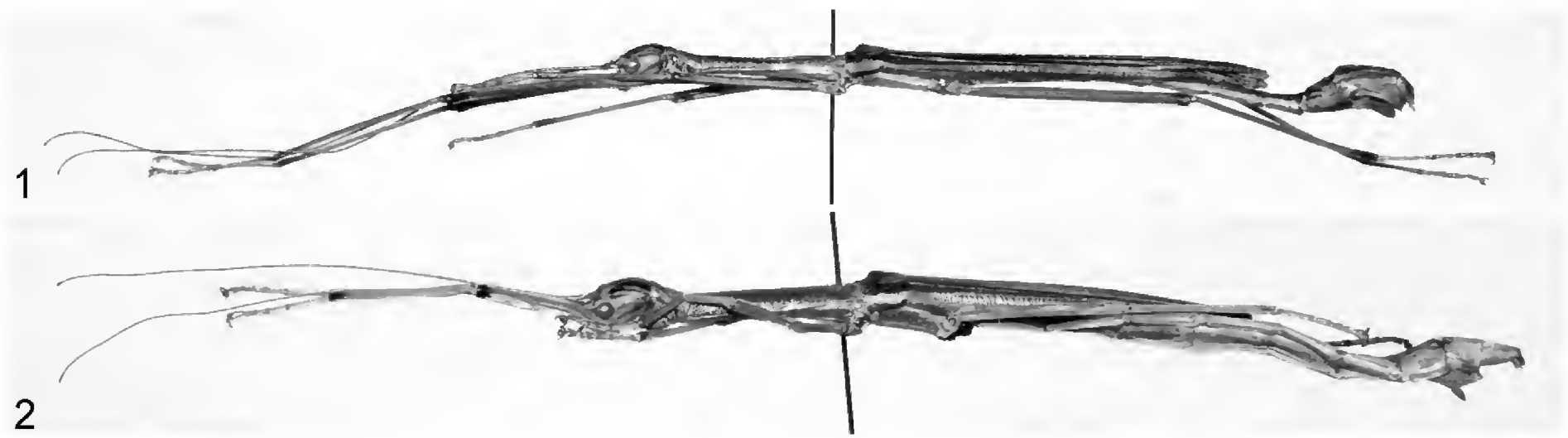
### *Sinophasma* Günther, 1940

<http://species-id.net/wiki/Sinophasma>

*Sinophasma* Günther, 1940: 240.

**Type species:** *Sinophasma klapperichi* Günther, 1940, by original designation.





**Figures 1–2.** Habitus images of *Sinophasma damingshanensis* sp. n. **1.** Male, lateral view; **2.** Female, lateral view.

**Notes:** While only one species occurs in Vietnam, all other twenty-five species and two subspecies are endemic to China.

***Sinophasma damingshanensis* Ho, sp. n.**

<http://zoobank.org/1083CC13-A904-4D1F-81F2-BC6AE050F016>

[http://species-id.net/wiki/Sinophasma\\_damingshanensis](http://species-id.net/wiki/Sinophasma_damingshanensis)

Figures 1–6

**Description:** Male. Medium-sized. General colour of body, wings and legs green. Body slender and slim.

Head green, with six blackish longitudinal stripes reaching hind margin of head. Smooth, lacking granulation. Oval, longer and broader than pronotum, slightly constricted behind eyes posteriorly. Vertex flat, with an oval and shallow depression between bases of antennae. Occiput convex, with distinct median furrow, lateral furrows indistinct. Compound eyes light brown, rounded and prominent, about 1.5 times length of genae. Antennae dark brown, densely covered with setae; filiform, longer than forelegs; first segment flattened at base, rectangular, parallel-sided, about 1.5 times length of second segment, shorter than third segment; second and third segments cylindrical.

Pronotum rectangular, transverse and longitudinal sulci crossing before middle, anterior margin curved inward, hind margin slightly rounded. Mesonotum densely granulated, elongate, more than 4 times length of pronotum, slightly parallel-sided, median line distinct, with a long carina along lateral margins. Mesopleura and mesosternum with inconspicuous and dense granules. Metapleura and metasternum smooth.

Abdomen dorsally green with brownish markings, ventral surface yellowish green. Smooth. Cylindrical and slender. Second to six terga parallel-sided, roughly equal in length. Seventh tergum gently expanded posteriorly. Eighth tergum trapezoid, gradually expanded posteriorly. Ninth tergum elongate and swollen, the longest, distinctly constricted medially, hind margin deeply emarginated; posterolateral angles elongate distinctly, apices obtuse; lateral margins raised. Anal segment rectangular, with a small horn medially; with ninth tergum vertically, longer than eighth tergum, reaching hind margin of anal segment; hind margin with four small emarginations, lateral angles elongate tuberculately. Poculum cup-shaped, hind margin rounded and broad. Cerci long and straight, cylindrical, apices rounded, not surpassing end of anal segment.

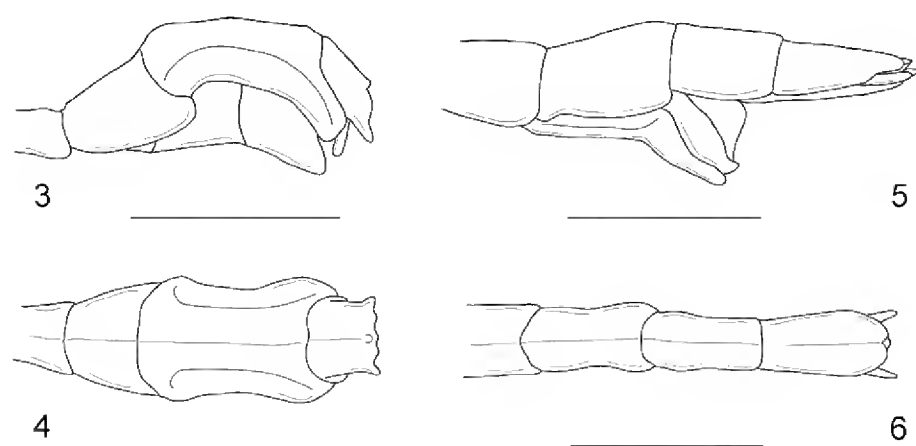
Tegmina brownish black, elevated angle blunt, with a yellow longitudinal stripe being laterad of elevation; oval, slightly as long as head, subtruncate posteriorly. Alae green, with dark brown longitudinal band, anal region dull rose; long, reaching posterior region of sixth tergum.

Legs slender and long. Unarmed, covered with dense and short bristles. Coxae rufous brown. Femora and tibiae green, black apically. Tarsi orange brown.

**Female.** Similar to male, but distinctly larger and robust. General colour of body, wings and legs green. Body slender and cylindrical.

Head greenish brown to light brown, occiput with six black longitudinal bands segregated by light brown longitudinal stripes. Smooth. Oval, distinctly longer than wide. Vertex flat, with a small oval depression between bases of antennae, its diameter as long as second antennal segment. Occiput distinctly convex, with median and lateral furrows. Compound eyes light brown, oval, about 2.5 times length of genae. Antennae dark brown, filiform, longer than forelegs; first segment slightly flattened at base, about 1.8 times length of second segment, as long as third segment.

Pronotum green, shorter than head, gently expanded posteriorly, with transverse and longitudinal sulci crossing before middle, anterior margin curved inward, hind margin truncate. Mesonotum green, densely covered with yellow and small granules; about 4 times length of pronotum, median line indistinct. Mesopleura, mesosternum, metapleura and metasternum densely granulated as in mesonotum. Metanotum smooth, longer than median segment.



**Figures 3–6.** *Sinophasma damingshanensis* sp. n. from Guangxi, China. **3.** Male, terminal end of abdomen, lateral view; **4.** Male, terminal end of abdomen, dorsal view; **5.** Female, terminal end of abdomen, lateral view; **6.** Female, terminal end of abdomen, dorsal view. [scale bar = 5 mm].

Abdomen dorsally and ventrally yellowish green. Smooth. Cylindrical, tapering posteriorly. Second to six terga roughly equal in length. Eighth tergum dilated into a slight and rounded lobe posterolaterally. Seventh sternum lacking preopercular organ. Anal segment slightly longer than ninth tergum, with small U-shaped notch on hind margin, lateral angles rounded. Supra-anal plate very small, hind margin rounded, exceeding hind margin of anal segment. Subgenital plate scoop-shaped, distinctly decurved in second half, strongly carinate laterally, apex pointed. Gonapophyses exposed, apex obtuse, reaching middle of ninth tergum. Cerci light brown, straight and cylindrical, apices pointed, surpassing hind margin of anal segment.

Tegmina brownish black, with light brown veins, elevated angle blunt, with a pale white longitudinal stripe being laterad of elevation; oval, longer than head, hind margin truncate. Alae green with dark brown longitudinal band, anal region dull rose; long, reaching middle of fifth tergum.

Legs slender and long. Unarmed. Coxae buff brown. Profemora and protibiae rufous green. Mesofemora, mesotibiae, metafemora and metatibiae green. Apices of femora and tibiae black. Tarsi rufous brown.

**Measurements.** Length (mm): Holotype: ♂, body length 52.0, antennae 41.0, head 3.0, pronotum 2.0, mesonotum 9.5, metanotum including median segment 7.5, profemora 14.0, mesofemora 10.0, metafemora 15.0, protibiae 12.0, mesotibiae 9.0, metatibiae 14.0. Paratypes: ♂, body length 51.0–52.0, antennae 34.0–36.0, head 3.0–3.5, pronotum 2.0–2.2, mesonotum 9.5, metanotum including median segment 7.0, profemora 12.5–13.0, mesofemora 9.0–10.0, metafemora 14.0, protibiae 11.0–12.0, mesotibiae 9.0, metatibiae 13.0–14.0, tegmina 2.5–3.0, alae 22.0–25.0. Paratypes: ♀, body length 59.0–73.0, antennae 29.0–43.0, head 4.0–5.0, pronotum 2.5–3.0, mesonotum 11.5–14.0, metanotum including median segment 7.0, profemora 11.0–15.0, mesofemora 8.0–10.0, metafemora 12.0–15.0, protibiae 9.0–14.0, mesotibiae 7.0–9.0, metatibiae 10.0–14.0, tegmina 3.5–4.5, alae 25.0–28.0.

**Type material:** China: holotype: ♂, Damingshan, Wuming, Guangxi, 28–31.VII.2012, Ho Wai-Chun George (HKES). Paratypes: 12♂, 8♀, Damingshan, Wuming, Guangxi, China, 28–31.VII.2012, Ho Wai-Chun George (HKES).

**Etymology:** This species is named after the type-locality, Damingshan.

**Distribution:** Guangxi, China.

**Notes:** This species is found in evergreen broadleaf forests.

**Differentiation:** Small *Sinophasma* species. This new species is separated from most species in the genus by its rectangular anal segment with a small horn medially in

male and seventh sternum lacking preopercular organ in female. *S. damingshanensis* Ho, sp. n. [Guangxi, China] is related to *S. unispinosum* Chen & Chen, 1997 [Guangdong, China] but can be separated by its greenish colour, smaller size and slenderer body in both sexes; absence of preopercular organ and decurved subgenital plate in female; and posterolaterally tuberculate anal segment in male.

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## References

- Bragg PE (2001) Phasmids of Borneo. Natural History Publications, Kota Kinabalu, Borneo.
- Chen SC, Chen PC (1997) Descriptions of two new species and one unknown female of the genus *Sinophasma* from Guangdong Province, China (Phasmatodea: Heteronemiidae). Journal of Beijing Forestry University 6(2): 93–99.
- Chen SC, Chen PC (1999) A new species of *Sinophasma* from Viet Nam (Phasmatodea: Heteronemiidae). Acta Entomologica Sinica 42(3): 300–302.
- Chen SC, He YH (2008) Phasmatodea of China. China Forestry Publishing House, Beijing.
- Günther K (1940) Neue Stabheuschrecken (Phasmoïden) aus China. – Decheniana 237: 237–248.
- Hennemann FH, Conle OV, Zhang WW (2008) Catalogue of the stick and leaf-insects (Phasmatodea) of China, with a faunistic analysis, review of recent ecological and biological studies and bibliography (Insecta: Orthoptera: Phasmatodea). Zootaxa 1735: 1–76.
- Ho GWC (2012) Notes on the genera *Sinophasma* Günther, 1940 and *Pachyscia* Redtenbacher, 1908 (Phasmatodea: Diapheromeridae: Necrosiinae), with the description of four new species from China. Zootaxa 3495: 57–72.
- Huang YSF (2013) *Sinophasma hoenei formosanum* Y.S. Huang, subsp. n., a new subspecies of stick insect from Taiwan (Phasmida: Diapheromeridae: Necrosiinae). Phasmid Studies 18: 39–51.
- Otte D, Brock PD (2005) Phasmida Species File - Catalog of stick and leaf insects of the world. The Insect Diversity Association and the Academy of Natural Sciences, Philadelphia.
- Shiraki T (1935) Orthoptera of the Japanese Empire (Part IV) Phasmidae. Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University, Formosa 14: 23–88.
- Zompro O (2004) Revision of the genera of the Areolatae, including the status of *Timema* and *Agathemera* (Insecta, Phasmatodea). Abhandlungen des Naturwissenschaftlichen Vereins Hamburg (NF) 37: 1–327.





# Revision of the flat bug family Aradidae from Baltic Amber IX. *Aradus macrosomus* sp. n. (Hemiptera: Heteroptera)

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## Abstract

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The present paper is a continuation of previous contributions describing fossil *Aradus* species from Baltic Amber inclusions (Heiss 1998, 2002, 2013). *Aradus macrosomus* sp. n. is a well- preserved large new species which is described and illustrated herein. It differs by a combination of characters from the known Eocene and extant *Aradus* taxa, documenting again the unexpected richness of species diversity preserved in Baltic Amber.

## Key Words

Hemiptera

Heteroptera

Aradidae

*Aradus*

new species

Baltic Amber

## Introduction

Baltic Amber, a fossilized tree resin found on or near the shores of the eastern Baltic Sea, represents the largest deposit of amber in the world. It is exceptionally rich in well-preserved inclusions of botanical and zoological objects, particularly arthropods. The origin, genesis, properties, age and the flora and fauna of Baltic Amber are largely discussed by Grimaldi (1996) and Weitschat and Wichard (1998).

Among the insect fauna, Heteroptera have attracted considerable attention and taxa from at least 3 aquatic and about 14 terrestrial bug families have been described since the first description by Germar and Berendt (1856; Weitschat and Wichard 2002, Grimaldi and Engel 2005).

Records of the flat bug family Aradidae are reported from the subfamilies Aneurinae (4 spp.: Heiss 1997, 2001, 2012), Calisiinae (6 spp.: Usinger 1941, Heiss

2000, 2002a), Mezirinae (1 sp.: Usinger 1941) and Aradinae (only genus *Aradus*).

To date 14 species of the genus *Aradus* have been described from Baltic amber inclusions, sharing all essential characters (e.g., habitus, structure of body, hemelytra and antennae) of this widely distributed extant genus (*A. assimilis*; *A. superstes*; *A. consimilis* Germar & Berendt, 1856; *A. frater* Popov, 1978; *A. frateroides* and *A. popovi* Heiss, 1998; *A. goellnerae* and *A. lativentris* Heiss, 2002b; *A. weitschati*, *A. kotashevichi*, *A. velteni*, *A. voigti*, *A. damzeni* and *A. balticus* Heiss, 2002c).

Another species, *A. grabenhorsti* Heiss, 2013 was described based on a specimen from Bitterfelder Amber (Saxonia, Germany), which presumably is of the same Eocene age as Baltic Amber. Specimens from Baltic Amber agree in all essential characters which could be assigned to this taxon and were thus included as paratypes in the type series.

## Material and methods

The Amber inclusion used in this study is preserved in the collection of the author at the Tiroler Landesmuseum, Innsbruck, Austria.

Photos were taken through an Olympus SZX 10 binocular microscope with Olympus E 3 digital camera and processed with Helicon Focus 4.3 software, using Adobe Photoshop and Lightroom 2.3.

Measurements were taken with a micrometer eyepiece, 20 units = 1 mm, and are given in millimetres, unless otherwise stated.

## Taxonomy

**Subfamily Aradinae** Brullé, 1836

**Genus *Aradus*** Fabricius, 1803

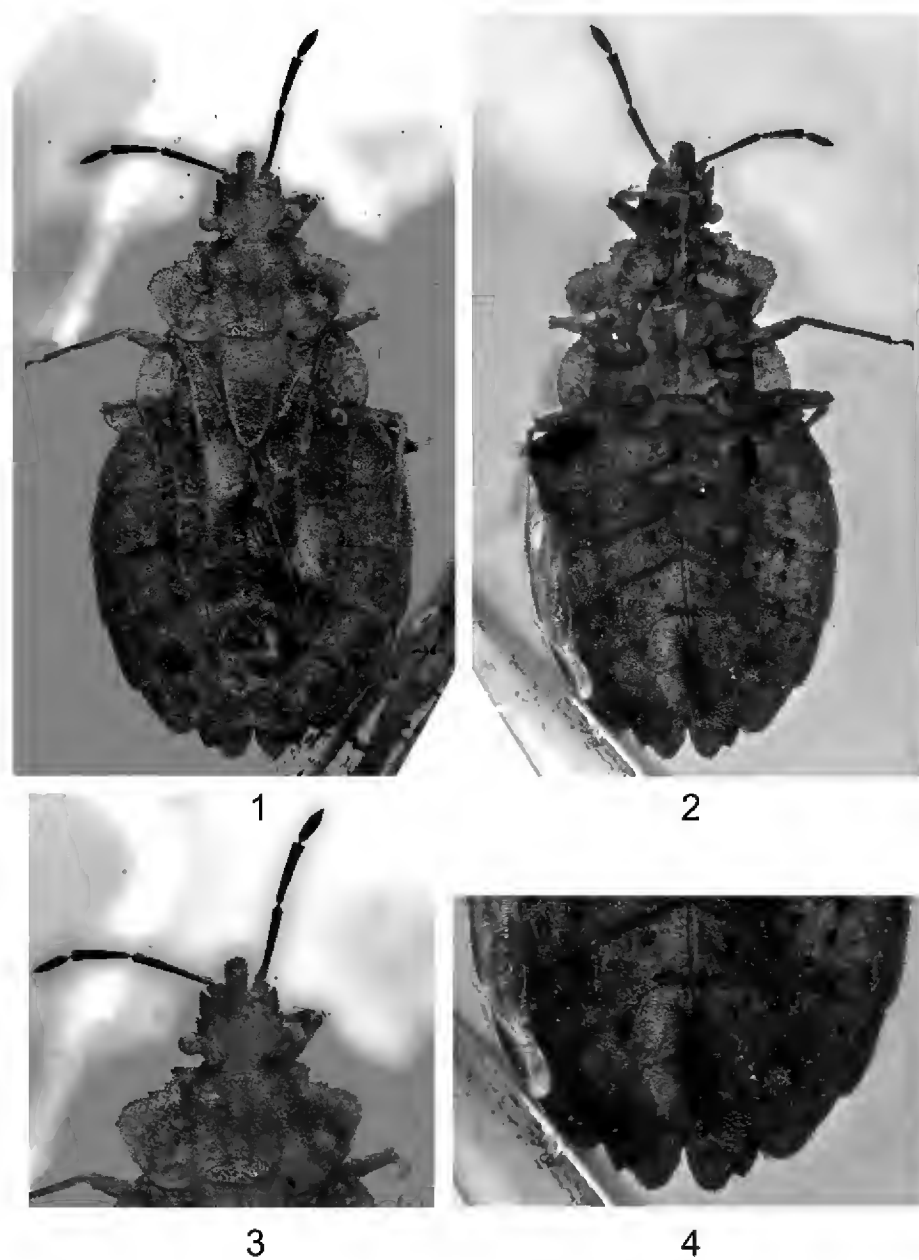
*Aradus macrosomus* sp. n.

<http://zoobank.org/6BC829E1-5481-4645-8CF5-C3396BEEC474>

[http://species-id.net/wiki/Aradus\\_macrosomus](http://species-id.net/wiki/Aradus_macrosomus)

Figs 1-4

**Material examined.** Holotype female in a honey-coloured transparent piece of Baltic Amber, which will be embedded in a block of epoxid resin (He-BB-Ar-40).



**Figures 1–4.** *Aradus macrosomus* sp. n., 1 – dorsal view; 2 – ventral view; 3 – head and pronotum, dorsal view; 4 – terminal segments, ventral view.

The specimen is dorsally and ventrally clearly visible, without a frequently occurring white incrustation (German: Verlumung). Antennae and legs are complete, the latter are bent ventrally.

**Diagnosis.** Species of larger size (9.2 mm) with long antennae, which are beset with tubercles bearing stiff bristles. Lateral margins of pronotum angulate and serrate, constricted anterolaterally. Abdomen widely rounded, connecting vein M-Cu of corium situated posterior to A-Cu.

**Description.** Macropterous female. Body with fine granulation. Colour light brown with darker patches on head, pronotum and hemelytra.

**Head.** Wider across eyes than long (32 / 29). Clypeus subparallel, twice as long as antennal segment I, apex rounded. Antenniferous tubercles subparallel, acute, shorter than antennal segment I. Lateral margins begranulate, a distinct preocular tubercle present. Antennae slender,  $1.72 \times$  as long as width of head; antennal segment I short but widest, here secondarily depressed; II longest, thinner at middle than at its ends; III shorter than II tapering toward base; IV shortest with pilose apex. Relative length of antennal segments I / II / III / IV = 6 / 23 / 17 / 11. Eyes reniform, large, protruding laterally. Postocular lobes rounded, their margins beset with some larger tubercles. Vertex with U-shaped depression. Rostrum arising from an open atrium, four-segmented, reaching anterior 1/3 of prosternum.

**Pronotum.**  $2.56 \times$  as wide as long (64 / 25). Lateral margins irregularly serrate, angularly expanded at middle then strongly converging and constricted anteriorly. Anterolateral angles rectangular, anterior margin straight. Surface only slightly convex, with 4 longitudinal carinae, the median ones of full length, the lateral ones shorter, reaching to shallow transverse impressions. Humeral angles slightly carinate. Posterior margin concave at middle, rounded laterally.

**Scutellum.** Triangular,  $1.60 \times$  as long as wide at base (40 / 25). Lateral margins straight and carinate, apex narrowly rounded. Disk elevated at basal 1/3, surface granulate.

**Hemelytra.** Basal lateral expansion of corium rounded; posterior angle of corium reaching posterior margin of dorsal external laterotergite (deltg) V. Veins distinct, M-Cu situated posterior to A-Cu. Membrane with 4 distinct veins, reaching to anterior margin of tergite VII, surface wrinkled.

**Abdomen.** Widely rounded; lateral margins of deltg II-VI slightly convex posteroexterior angles not produced; deltg VII broadly rounded posteriorly, paratergites VIII cleft at middle, apex rounded with a blunt lateral tooth. Ventral side with a longitudinal groove, reaching from sternite VIII to prosternum. Spiracles II-VII ventral and far from lateral margin, VIII lateral and visible from above.

**Legs.** Femora fusiform, trochanters fused along visible sutures. Tibiae cylindrical, slender, protibial comb present. Tarsi two segmented with slender curved claws lacking pulvilli.

**Measurements.** Length 9.2 mm; length of antennae 2.25 mm; width of abdomen 5.05 mm; width of corium 3.75 mm; width of tergite VIII 1.7 mm.

**Etymology.** The epithet refers to its unusual large size, from “macros” <Greek> large and “soma” <Greek> body.

## Discussion

The new species can be distinguished at once from all other species of *Aradus* described so far of Baltic amber by a combination of characters not occurring otherwise, e.g., its large size, wide rounded body, structure of head with reniform laterally protruding eyes, long and thin antennae, and shape of the pronotum and scutellum. It shows only a superficial similarity to *A. lativentris* Heiss (2002b) and *A. velteni* Heiss (2002c), which, however, are of smaller size and the structure and shape of head, antennae and pronotum are different. There does not seem to be a close relationship with the extant species of *Aradus*.

## Acknowledgments

I am grateful to Marius Veta (Palanga, Lithuania) who provided the Amber inclusion, Stefan Heim (Tiroler Landesmuseum) for the photos and Dominique Zimmermann, the newly appointed editor-in-chief for the Deutsche Entomologische Zeitschrift, who invited me to contribute to this issue and the reviewers for their critical reading and suggestions.

## References

- Brullé A (1836) Histoire naturelle des insects, traitant de leur organisation et de leurs moeurs en général, et comprenant leur classification et la description des espèces. Pillot, Paris.
- Germar EF, Berendt GC (1856) Die im Bernstein befindlichen Hemipteren und Orthopteren der Vorwelt. In: Berendt CG (Ed) Die im Bernstein befindlichen organischen Reste der Vorwelt 2, Berlin: 1–40.
- Grimaldi DA (1996) Amber: Window of the past. American Museum of Natural History, Harry N. Abrams, Inc and American Museum of Natural History, New York, 216 pp.
- Grimaldi DA, Engel MS (2005) Evolution of the Insects. Cambridge University Press, 755 pp.
- Heiss E (1997) Erstnachweis einer Aneurinae aus dem Baltischen Bernstein: *Aneurus ancestralis* n. sp. (Heteroptera, Aradidae). *Carolinea* 55: 111–113.
- Heiss E (1998) Revision der Familie Aradidae des Baltischen Bernsteins I: Bisher beschriebene Taxa der Gattung *Aradus* und zwei neue Arten (Insecta, Heteroptera). *Mitteilungen des Geologisch-Paläontologischen Instituts der Universität Hamburg* 81: 251–268.
- Heiss E (2000) Revision der Familie Aradidae des Baltischen Bernsteins II. Drei neue *Calisius*-Arten (Insecta, Heteroptera). *Carolinea* 58: 195–201.
- Heiss E (2001) Revision der Familie Aradidae des Baltischen Bernsteins III. Zwei neue *Aneurus*-Arten (Insecta, Heteroptera). *Entomologisches Nachrichtenblatt* 8: 12–18.
- Heiss E (2002a) Revision der Familie Aradidae des Baltischen Bernsteins V. Eine neue Gattung und zwei neue Arten der Unterfamilie Calisiinae (Heteroptera, Aradidae). *Linzer biologische Beiträge* 34/2: 1127–1136.
- Heiss E (2002c) Revision der Familie Aradidae des Baltischen Bernsteins VI: Neue Arten der Gattung *Aradus* Fabricius 1803 (Heteroptera, Aradidae). *Linzer biologische Beiträge* 34(2): 1137–1150.
- Heiss E (2002b) Revision of the family Aradidae in Baltic Amber IV: Two new *Aradus* from the collection of the Institut für Paläontologie, Museum für Naturkunde, Berlin (Heteroptera, Aradidae). *Mitteilungen des Naturkundemuseums Berlin, Deutsche Entomologische Zeitschrift* 49: 221–225. doi: 10.1002/mmnd.20020490207
- Heiss E (2012) Revision der Aradidae des Baltischen Bernsteins VII. Eine neue *Aneurus*-Art (Hemiptera: Heteroptera). *Entomologische Zeitschrift* 122(3), Stuttgart, 109–110.
- Heiss E (2013) Erstnachweis von Rindenwanzen (Aradidae) in Bitterfelder Bernstein (Insecta, Heteroptera). *Linzer biologische Beiträge* 45 (1): 741–753.
- Popov YA (1978) New species of Aradidae (Hemiptera) from the Baltic Amber. *Prace Muzeum Ziemi* 29: 137–140.
- Usinger RL (1941) Two New Species of Aradidae from Baltic Amber (Hemiptera). *Psyche* 48: 96–100. doi: 10.1155/1941/72496
- Weitschat W, Wichard W (1998) Atlas der Tiere und Pflanzen im Baltischen Bernstein. Verlag F. Pfeil, München, 256 pp.
- Weitschat W, Wichard W (2002) Atlas of Plants and Animals in Baltic Amber. Verlag F. Pfeil, Munich, 256 pp.



# Description of hitherto unknown fundatrices of *Stomaphis graffii* and *S. longirostris* (Hemiptera, Aphididae, Lachninae)

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## Abstract

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The hitherto unknown fundatrices of two large aphid species having a cryptic mode of life, *Stomaphis graffii* Cholodkovsky, 1894 and *S. longirostris* (Fabricius, 1787), are described from specimens collected in Poland. Key to identification of known fundatrices of European representatives of the genus *Stomaphis* is provided and the observed morphological features are discussed.

## Key Words

Aphids

Lachninae

fundatrix

host specificity

## Introduction

The genus *Stomaphis* Walker comprises about 30 aphid species distinctive because of their large body size and very long rostrum. Such a long rostrum, much longer than the body, enables them to probe through the bark of the trees, mainly deciduous, on which they feed (Blackman and Eastop 1994). Species of the genus *Stomaphis* are generally monoecious (their life cycle requires only a single host plant species) with one possible exception (Takada 2008). Despite their large body size, these aphids are relatively rarely found, due to their cryptic life mode (Depa et al. 2012), and as a result little is known of the bionomy of many species. In some cases there exist only descriptions of viviparous females (Qiao and Zhang 1999). That is also why there are accounts of the first spring generation – the fundatrix – for only two *Quercus*-feeding species, *S. quercus* (L.) (Lorenz and Scheurer 1998) and *S. wojciechowskii* Depa (Depa and Mróz 2012). This paper aims at adding to our knowledge of the morphology of this group of aphids by providing descrip-

tions of the fundatrices of two other common European representatives of the genus which feed on Aceraceae and Salicaceae, *S. graffii* and *S. longirostris*, and comparing them with the other fundatrices known in this genus.

## Materials and Methods

- 15.06.2012. Piekary Śląskie, Poland, 50°24'11.85"N; 18°56'5.07"E. Base of trunk of *Populus nigra*, under the bark, associated with *Lasius brunneus*, leg. Ł. Depa. *Stomaphis longirostris* det. Ł. Depa, 4 fundatrices.
- 19.05.2012. Świerklaniec, Poland, 50°26'5.36"N; 18°56'49.84"E. Base of trunk of *Acer pseudoplatanus*, under the bark, associated with *Lasius brunneus*, leg. Ł. Depa. *Stomaphis graffii* det. Ł. Depa, 5 fundatrices.

Additional material studied:

- 02.06.2011, Piekary Śląskie, Poland, 50°24'11.48"N, 18°57'47.87"E, Dioblina forest, the trunk of *Quercus*



*robur*, associated with *Lasius brunneus*, leg. Ł. Depa. *Stomaphis wojciechowskii* det. Ł. Depa, 2 fundatrices.  
- 10.06.2011, Bobrowniki, Poland, 50°22'38.8"N, 18°59'50.5"E, trunk of *Betula pendula*, associated with *Lasius fuliginosus*, leg. Ł. Depa. *Stomaphis quercus* det. Ł. Depa, 2 fundatrices.

Measurements and photographs were made by the Nikon Eclipse E600 microscope. Microscopic slides with the studied specimens are deposited in the collection of Zoology Department of the University of Silesia, Katowice, Poland.

For comparison, basic morphometric data of *S. acquerinoi* and *S. knechteli* were obtained from Binazzi (2001), Binazzi and Blackman (2003), *S. juglandis* from Petrović (1998) and *S. cupressi* from Pintera (1965) and Mamontova (2012). Some morphometric data of apterous viviparous females were provided from Depa and Mróz (2013).

Principal Component Analysis of the key morphological (second segment of hind tarsus (HTII)/second segment of middle tarsus (MTII), number of setae on labrum, number of rhinaria on antennal segment III, number of rhinaria on antennal segment IV, sclerites on abdominal tergite VII) and ecological traits (host plant, holocycle/anholocycle) was also applied in order to determine the similarity of representatives of the *S. longirostris* – group of species and the described fundatrices. For analysis the MVSP 3.21 by Kovach Computing Services program was applied.

## Results

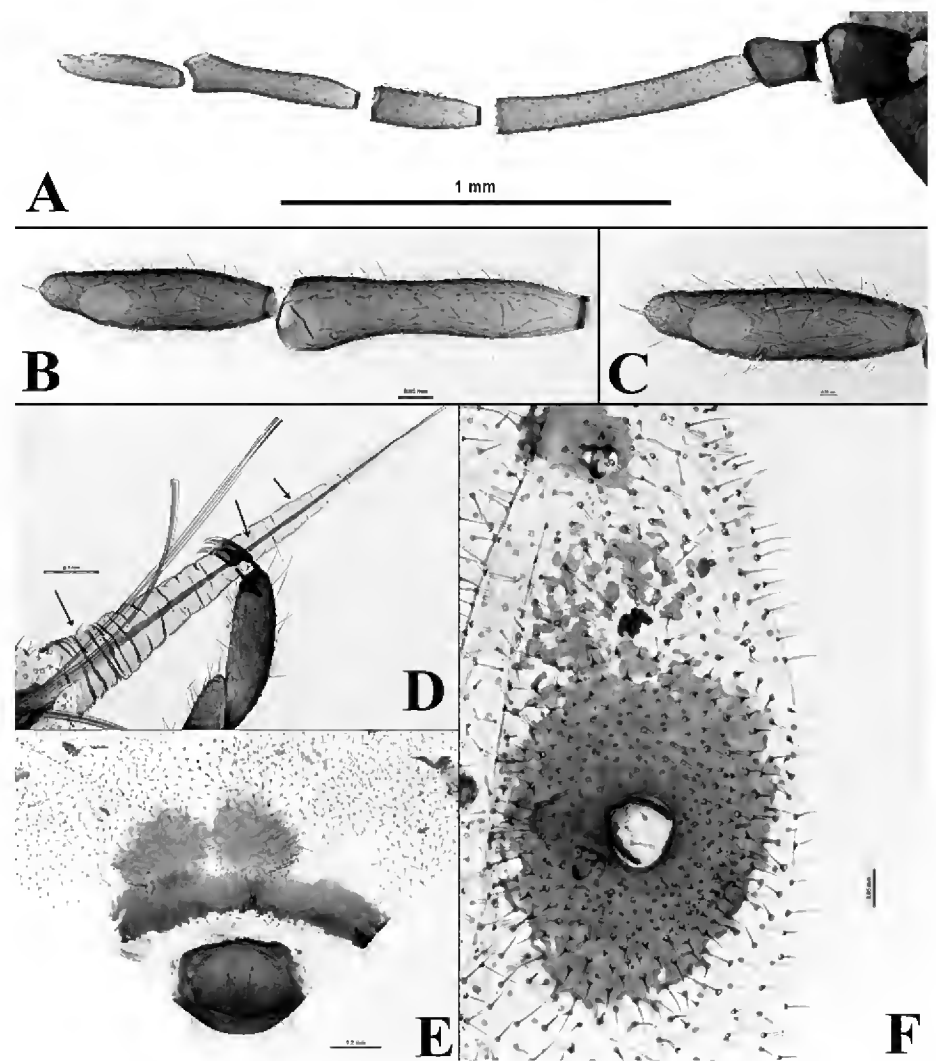
### *Stomaphis longirostris*

[http://species-id.net/wiki/Stomaphis\\_longirostris](http://species-id.net/wiki/Stomaphis_longirostris)

Fundatrix (Fig. 1, Table 1)

**Description:** Body large, oval. Head distinctly sclerotised, dark. Antennae pale, with first two segments darker, densely covered with short setae (Fig. 1a). Legs dark, with only middle of tibiae slightly paler. Head covered with numerous short setae. Epicranial suture well developed. Eyes small, with triommatidia not well separated. Antennae 0.13 – 0.34 times body length. Antennal segments IV and VI shorter than V, which is thinner in the middle of its length (Fig. 1b, compare with apterous viviparous female – Fig. 3ab). Antennal ratios: ant. segm. III/ segm. IV+V+VI 0.62 – 0.64; segm. III/ segm. IV 2.03 – 2.42; segm. IV/ segm. V 0.60 – 0.83; segm. V/ segm. VI 1.24 – 1.57; segm. VI base/ segm. VI terminal process 4.30 – 6.25. Secondary rhinaria of unequal diameter on III and IV antennal segments. Accessory rhinaria on antennal segment VI diffused on the base of segment. Terminal process subequal to the diameter of primary rhinarium, with nodose protuberances at the apex (Fig. 1c). Rostrum longer than body. Labrum covered with 1–5 setae (Fig. 1d). Apical segment of rostrum (ARS) 1.64 – 1.79 times HT II and 2.46 – 2.95 ant. segm. VI terminal process, with numerous accessory setae.

Prothorax dark, with spinal and marginal sclerotizations. Meso- and metathorax with marginal sclerites only.



**Figure 1.** *Stomaphis longirostris* – fundatrix: (a) antenna, (b) antennal segments V and VI, (c) antennal segment VI, (d) labrum (arrows indicate setae), (e) distal part of abdomen with subgenital plate and cauda, (f) siphuncular sclerite.

Mesothoracic furca small, well separated. Metathoracic furca reduced, only in form of small, distinctly sclerotised protuberances. Legs covered by long and pointed setae, as long as the diameter of tibia in the middle. HT II 1.26 – 1.36 times second segment of middle tarsus (MT II). Ratio of ant. segm. IV to HT II 0.68 – 0.81.

Abdomen membranous, covered with fine, long setae, with three rows of dark, intersegmental insertions. Spiracles on very small, pigmented sclerites. Siphuncular pores on distinct, sclerotised cones. Anterior part of the cone often extended, broken into smaller scleroites (Fig. 1f, unlike in apterous viviparous female – Fig. 3d). Weak, paired spinal sclerites, often broken into many small scleroites, sometimes absent, on abdominal tergite VII. Abdominal tergite VIII distinctly and uniformly sclerotised, covered with a few rows of long setae in the posterior part of the tergite. Subgenital plate separated into two big sclerites, covered with long setae. Cauda rounded, sclerotised, covered with many long setae (Fig. 1e).

**Diagnosis:** From the apterous viviparous female it may be distinguished by (fundatrix vs apterous viviparous female):

- lower ratio of ant. segm. IV to ant. segm. V: 0.6 – 0.83 vs 0.67 – 1.03
- higher ratio of ant. segm. V to ant. segm. VI: 1.24 – 1.57 vs 0.96 – 1.32
- lower ratio of second segment of hind tarsus (HT II) to second segment of middle tarsus (MT II): 1.26 – 1.36 vs 1.36 – 1.43

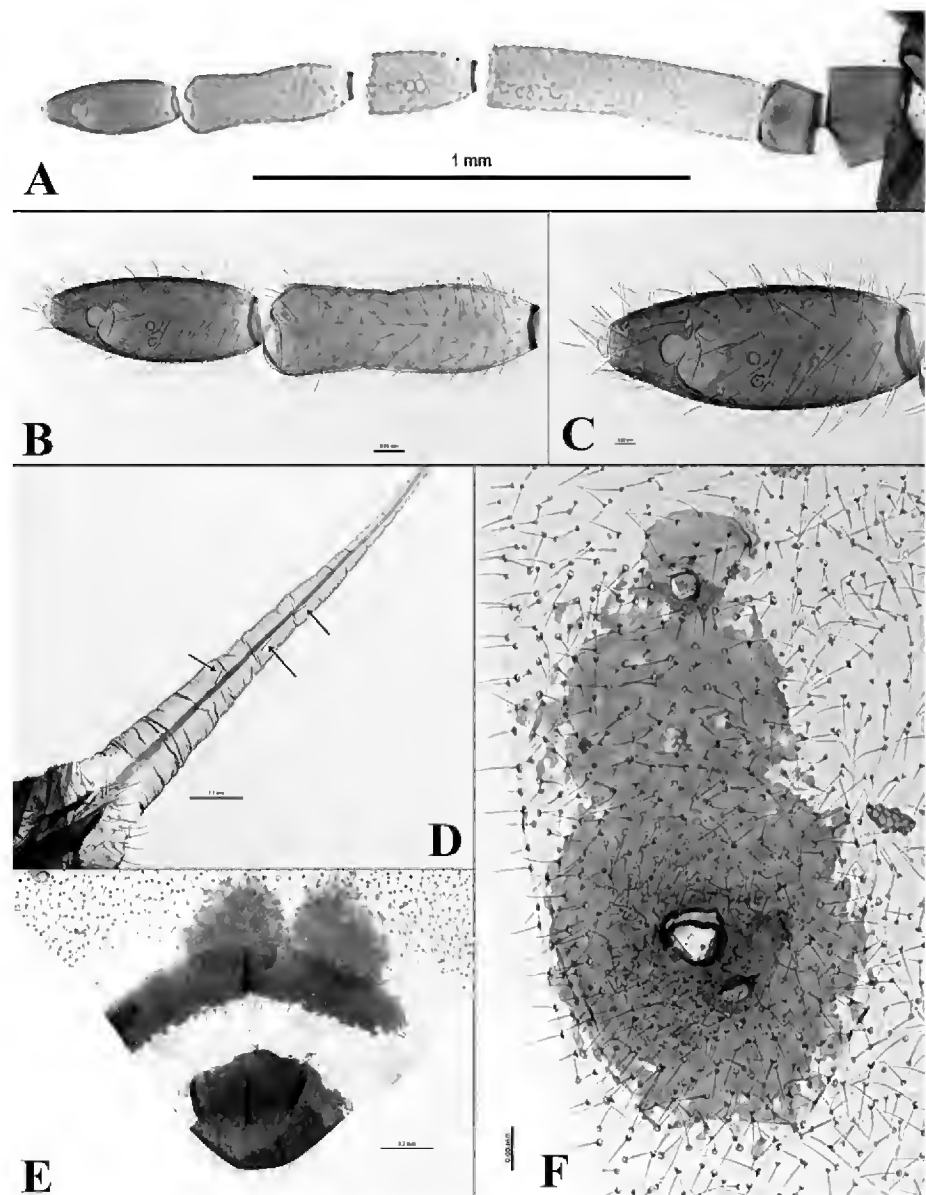
***Stomaphis graffii***

[http://species-id.net/wiki/Stomaphis\\_longirostris](http://species-id.net/wiki/Stomaphis_longirostris)

Fundatrix (Fig. 2, Table 1)

**Description:** Body large, oval. Head distinctly sclerotised, dark. Antennae pale, but with apices of segments (especially V and VI) darker, densely covered with short setae (Fig. 2a). Prothorax dark. Legs dark, with only middle of tibiae slightly paler at the ventral margin. Head covered with short setae. Epicranial suture well developed. Eyes small, with triommatidia not well separated. Antennae 0.31 – 0.34 times body length. Antennal segments IV and VI shorter than ant. segm. V, which is slightly thinner in the middle of its length (Fig. 2b). Antennal ratios: ant. segm. III/ segm. IV+V+VI 0.65 – 0.67; segm. III/ segm. IV 2.44 – 2.87; segm. IV/ segm. V 0.56 – 0.67; segm. V/ segm. VI 1.17 – 1.32; segm. VI base/ segm. VI terminal process 3.12 – 4.16. Secondary rhinaria of unequal diameter on ant. segm. III and segm. IV. Accessory rhinaria on ant. segm. VI diffused on the base of segment. Terminal process slightly longer than the diameter of primary rhinarium, with nodose protuberances at the apex (Fig. 2c). Rostrum longer than body. Labrum covered with 6–14 setae (Fig. 2d). ARS 1.41 – 1.60 times HT II and 2.14 – 2.56 ant. segm. VI terminal process, with numerous accessory setae.

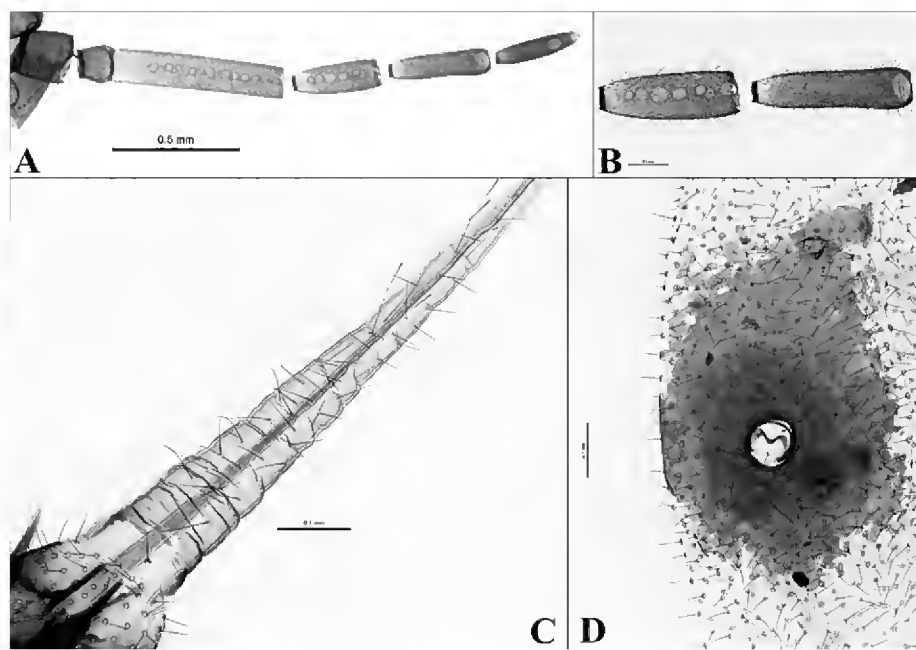
Prothorax with spinal and marginal sclerotizations. Meso- and metathorax with marginal sclerites only. Meso- and metathoracic furca small, well separated. Metathoracic furca reduced, only in form of small, distinctly sclerotised protuberances. Legs covered by long setae, as long as the



**Figure 2.** *Stomaphis graffii* – fundatrix: (a) antenna, (b) antennal segments V and VI, (c) antennal segment VI, (d) labrum (arrows indicate setae), (e) distal part of abdomen with subgenital plate and cauda, (f) siphuncular sclerite.

**Table 1.** *Stomaphis longirostris* (n = 4) and *Stomaphis graffii* (n = 5). Measurements of fundatrices (in mm).

Character	<i>S. longirostris</i>	<i>S. graffii</i>
Body length	6.27 – 6.55	5.95 – 6.05
Antennae length	1.95 – 2.16	1.89 – 2.05
Ant. segm. III	0.63 – 0.69	0.63 – 0.72
Ant. segm. IV	0.28 – 0.31	0.23 – 0.27
Ant. segm. V	0.36 – 0.46	0.40 – 0.42
Ant. segm. VI	0.28 – 0.31	0.31 – 0.34
Ant. VI terminal process	0.04 – 0.06	0.06 – 0.08
Ant VI base	0.23 – 0.26	0.25 – 0.27
Apical segment of rostrum	0.64 – 0.68	0.58 – 0.64
Second segment of middle tarsus	0.30 – 0.32	0.30 – 0.31
First segment of hind tarsus	0.14 – 0.15	0.13 – 0.15
Second segment of hind tarsus	0.38 – 0.41	0.39 – 0.41
SIPH sclerite length	0.54 – 0.62	0.65 – 0.80
SIPH sclerite width	0.30 – 0.39	0.37 – 0.46
Subgenital plate length	0.54 – 0.62	0.32 – 0.35
Subgenital plate width	0.69 – 0.75	0.75 – 0.80
Rhinaria on ant. segm. III	0 – 7	4 – 9
Rhinaria on ant. segm. IV	4 – 6	3 – 5
Rhinaria on ant. segm. V	1 – 2	1 – 2
Rhinaria on ant. segm. VI	3 – 6	4 – 6
Number of ommatidia	17 – 23	10 – 20



**Figure 3.** *Stomaphis longirostris* – apterous viviparous female: (a) antenna, (b) antennal segments III and IV, (c) labrum, (d) siphuncular sclerite.

diameter of tibia in the middle. HT II 1.30 – 1.36 times MT II; ant. segm. IV/ HT II 0.51 – 0.67;

Abdomen membranous, covered with fine, long setae, with three rows of dark, intersegmental insertions.

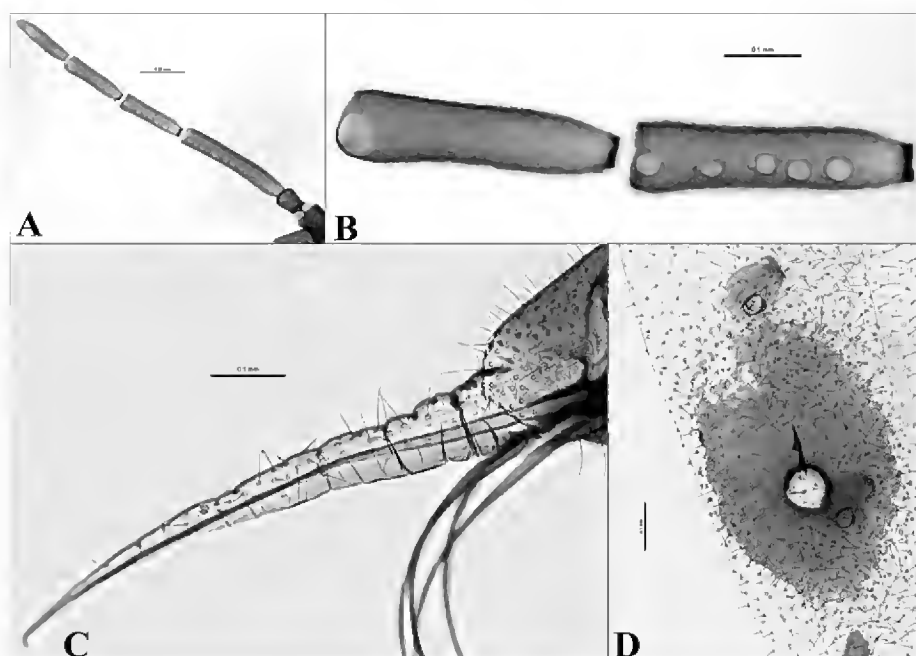
Spiracles on very small, pigmented scleroites. Siphuncular pores on distinct, sclerotised cones. Anterior part of the cone always extended and paler (Fig. 2f, unlike in apterous viviparous female – Fig. 4d). Weak, paired spinal sclerites, always broken into a few small scleroites, sometimes present on abdominal tergite VII. Abdominal tergite VIII distinctly and uniformly sclerotised, covered with a few rows of long setae in the posterior margin of the tergite. Subgenital plate separated into two big sclerites, covered with long setae. Cauda rounded, sclerotised, covered with many long setae (Fig. 2e).

**Diagnosis:** From the apterous viviparous female it may be distinguished by (fundatrix vs apterous viviparous female):

- higher ratio of ant. segm. III to ant. segm. IV: 2.44 – 2.87 vs 1.55 – 2.46
- lower ratio of ant. segm. IV to ant. segm. V: 0.56 – 0.67 vs 0.76 – 1.16
- lower ratio of ant. segm. IV to HT II: 0.52 – 0.67 vs 0.69 – 0.92

#### Key to known fundatrices of European species of the genus *Stomaphis*

- 1 Ventral plates present; spinal, paired sclerites present..... 2
- Ventral plates absent; spinal, paired sclerites present at most on VII abdominal segment, absent from other abdominal segments..... 3
- 2 R IV+V/HT II < 2.0, in life pale, dull, slightly wax powdered..... *S. wojciechowskii* Depa
- R IV+V/HT II > 2.0, in life dark, shining..... *S. quercus* (L.)
- 3 R IV+V/HT II > 1.64, antIII/antIV < 2.43, less than 5 setae on extended part of labrum..... *S. longirostris* (F.)
- R IV+V/HT II < 1.61, antIII/antIV > 2.44, more than 5 setae on extended part of labrum..... *S. graffii* Cholod



**Figure 4.** *Stomaphis graffii* – apterous viviparous female: (a) antenna, (b) antennal segments III and IV, (c) labrum, (d) siphuncular sclerite.

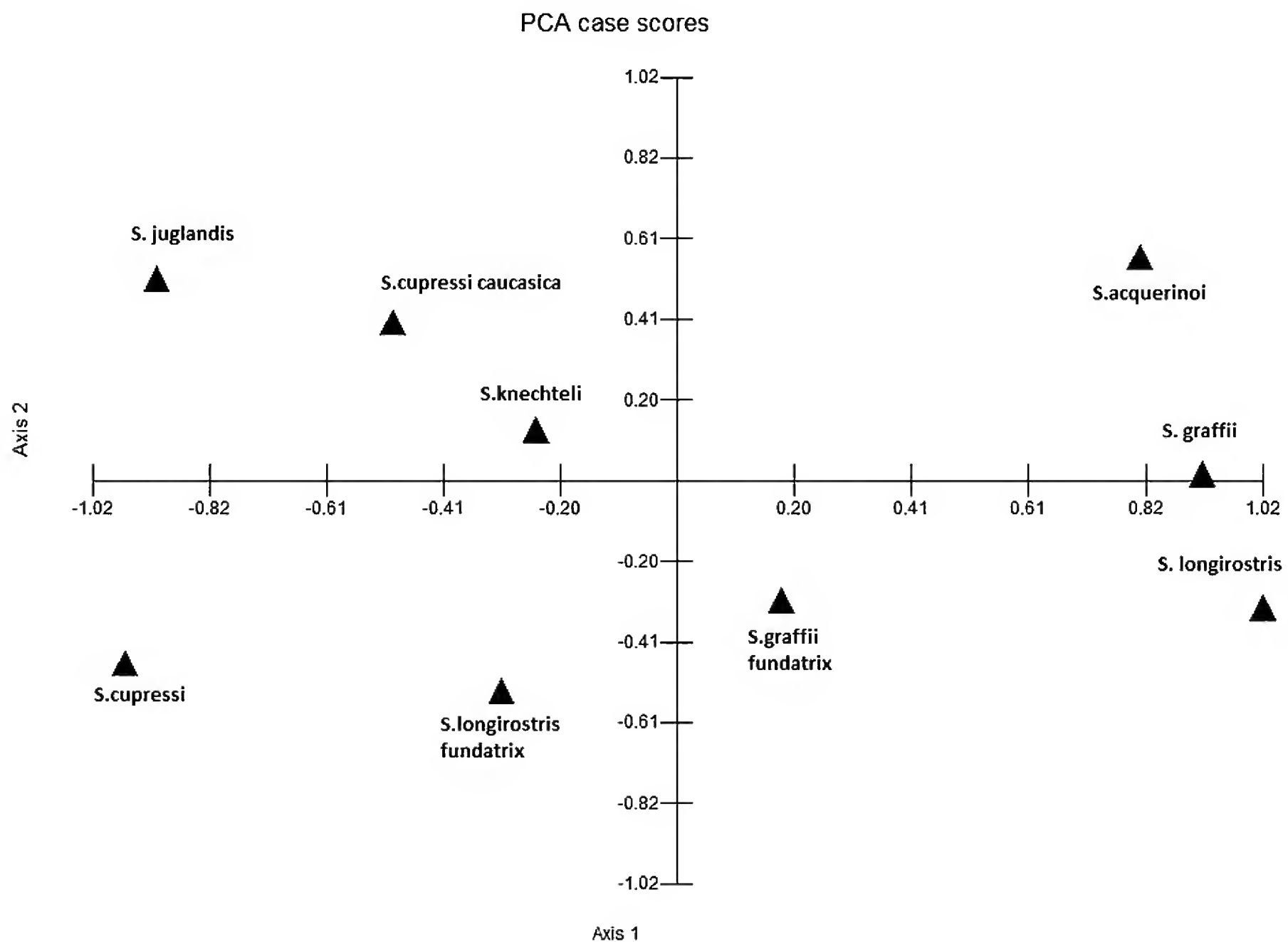
## Discussion

The two morphs show some interesting features in their morphology, differentiating them from apterous viviparous morphs of both species.

The fundatrix of *S. graffii* is rather congruent in morphological features with its apterous viviparous morph, except for minor traits (as listed in the description), among which the more significant is the very short antennal segment IV (Fig. 2a and Fig. 4ab for comparison). The main characteristics of the species: HTII/MTII ratio and number of secondary rhinaria are within the range of variability typical for apterous viviparous females (Binazzi and Blackman 2003). Also the number of setae on labrum, although slightly smaller in fundatrices (6–14), matches the range of variability of apterous viviparous females (Fig. 4c) (3 – 26 according to Binazzi and Blackman (2003), 4 – 56 according to Depa and Mróz (2013)).

The most interesting morphological feature is the very low number of setae on the labrum of fundatrix of *S. longirostris* (Fig. 1d), which are hardly visible in the mounted specimens as they are prone to be broken off during mounting. Apterous viviparae of later generations (fundatrigeniae, virginogeniae and sexuparae) of this species have more than 20, and often up to 40 setae on the labrum (Fig. 3c), distributed along its entire length (Binazzi and Blackman 2003). Lack of setae on labrum makes the fundatrix of this species similar to the apterous vivip-





**Figure 5.** The results of PCA, showing similarity of the fundatrix of *S. longirostris* to *S. cupressi*.

arous female of *S. cupressi* Pintera – a species originally described from *Cupressus* in Kenya (Pintera 1965) but known also from the western Mediterranean region and Black Sea shores (Blackman and Eastop 1994; Akyürek et al. 2010). Fundatrices of *S. longirostris* also resemble apterous viviparous females of later generations of *S. cupressi* by having their HTII/MTII ratio less than 1.36, and could be mistakenly identified as that species (they also have as similar number of secondary rhinaria on antennal segments III and IV) if the host were unknown.

The PCA analysis confirmed the similarity of described fundatrices of *S. longirostris* to the *S. cupressi* (Fig. 5), with the most informative factors being the number of setae on labrum and the number of secondary rhinaria on antennal segment III. Species on the left side of the graph showed in Fig. 5 are species with a few setae on labrum while species on the right possess many setae on labrum. Similarly, species above the axis 2 in Fig. 5 have more rhinaria on antennal segment III while species below axis 2 have less rhinaria on this segment.

In the respect of analysed morphological traits, it seems that fundatrices of both studied species of *Stomaphis* show retrogressive features, which is concordant with the general view of aphid morphology, as reviewed by Miyazaki (1987). Among them, the most significant is the lack of setae on the elongated part of labrum

of *S. longirostris*. If setae on the labrum play some role as receptors during feeding, it is interesting that *S. longirostris* exhibits such a radical loss of setae in its fundatrix, while the closely related species *S. graffii* does not. The phenomenon of weakening of sensory structures in the fundatrix during process of host specialization suggested by Shaposhnikov (1987) seems to be the explanation.

## Conclusion

Fundatrices of both studied species showed some retrogressive morphological features, although did not show significant departure from general morphology of apterous viviparous females. *S. longirostris* showed larger reduction of setae on labrum than *S. graffii*, which is interesting in respect to phylogeny and host specificity of the genus.

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## References

- Akyürek B, Zeybekoğlu Ü, Görür G (2010) New records of aphid species (Hemiptera: Aphidoidea) for the Turkish fauna from Samsun province. *Turkish Journal of Zoology* 34: 421–424.
- Binazzi A (2001) A new species of *Stomaphis* Walker from Italy, *S. acquerinoi* sp. n. (Aphididae Lachninae). *Redia* 84: 91–103.
- Binazzi A, Blackman RL (2003) The *Acer*-feeding *Stomaphis* with description of a new species and new morphs (Hemiptera Aphididae Lachninae). *Redia* 86: 7–16.
- Blackman RL, Eastop VF (1994) Aphids on the World's trees, An identification and information guide. CAB International & The Natural History Museum, London. [www.aphidsonworldsplants.info](http://www.aphidsonworldsplants.info)
- Depa Ł, Mróz E (2012) Description of fundatrix morph of *Stomaphis wojciechowskii* Depa 2012 (Aphidoidea: Lachnidae). *Genus* 23(3): 425–428.
- Depa Ł, Mróz E (2013) Central European *Acer* - and Salicaceae-feeding Aphids of the Genus *Stomaphis* (Insecta: Aphidoidea: Lachnidae). Separate Species or Populations? *Zoological Science* 30(6): 509–518. doi: 10.2108/zsj.30.509
- Depa Ł, Mróz E, Szawaryn K (2012) Molecular identity of *Stomaphis quercus* (Hemiptera: Aphidoidea: Lachnidae) and description of a new species. *European Journal of Entomology* 109: 435–444. doi: 10.14411/eje.2012.056
- Lorenz H, Scheurer S (1998) Biology and generation-order of *Stomaphis quercus* (Lachnidae) living on *Betula pendula* near Berlin, Germany. In: Nieto Nafria JM, Dixon AFG (Eds) Aphids in natural and managed ecosystems. Secretariado de publicaciones, Universidad de León, 243–250.
- Mamontova WA (2012) Lachnid aphids (Homoptera: Aphidoidea: Lachnidae) from Eastern Europe and adjacent territories. Ukrainian Academy of Science, Naukova Dumka, Kiev, 390 pp. [in Ukrainian]
- Miyazaki M (1987) Forms and morphs of aphids. In: Harrewijn P, Minks AK (Eds) Aphids. Their biology, natural enemies and control. A. Elsevier, Amsterdam, 163–195.
- Petrović O (1998) A new species of *Stomaphis* Walker (Aphididae) from Serbia. In: Nieto Nafria JM, Dixon AFG (Eds) Aphids in natural and managed ecosystems. Secretariado de publicaciones, Universidad de León, 423–429.
- Pintera A (1965) Two new species of Lachnidae in the collections of the British Museum (Hemiptera, Aphidoidea). *Entomologist* 98: 60–63.
- Qiao G, Zhang G (1999) A revision of *Stomaphis* Walker from China with descriptions of three new species (Homoptera, Lachnidae). *Entomologia Sinica* 6(4): 289–329.
- Shaposhnikov GCh (1987) Evolution of aphids and relations to evolution of plants. In: Harrewijn P, Minks AK (Eds) Aphids. Their biology, natural enemies and control. A. Elsevier, Amsterdam, 409–414.
- Takada H (2008) Life cycles of three *Stomaphis* species (Homoptera: Aphididae) observed in Kyoto, Japan: possible host alternation of *S. japonica*. *Entomological Science* 11: 341–348. doi: 10.1111/j.1479-8298.2008.00276.x

# The immature stages of the necrophagous fly *Liopiophila varipes* and considerations on the genus *Liopiophila* (Diptera: Piophilidae)

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## Abstract

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The preimaginal stages of *Liopiophila varipes* (Meigen, 1830) (Diptera: Piophilidae), the only species of the genus *Liopiophila* Duda, are described. The first and second-instar larvae and the puparium are described for the first time. The morphology of the third-instar larva is described in detail and compared with previous descriptions. Despite recent classifications suggested considering *Liopiophila* as a synonym of *Prochyliza* Walker, the presence of two rows of spines on the ventral creeping welts and fan-shaped anterior spiracles with lobes arranged in two groups in larvae and puparium support the validity of *Liopiophila* as a genus and its consideration as the sister group of the genus *Stearibia* Lioy. A key to the genera of the subtribe Piophilina based on the known larvae is provided.

## Introduction

Widely distributed throughout the world but mainly represented in the cooler and temperate regions of the Northern Hemisphere (McAlpine 1977), the family Piophilidae is a small group of Diptera containing about 70 species (Ozerov 2004). Most of its species are scavengers; both adults and larvae can be frequently found on carcasses, preferably in advanced stages of decay (Martín-Vega 2011). Due to the attraction to proteinaceous animal matter and the synanthropic or hemisynanthropic habits of several species, they can represent economically important pests for the food industry (Zuska and Laštovka 1965).

*Liopiophila varipes* (Meigen, 1830) is a piophilid species with Holarctic distribution, frequently cited in association with carrion (e.g. Anton et al. 2011; Martín-Vega and Baz 2013). Despite *L. varipes* appears to be of smaller economic and hygienic importance than other piophilid species, it may be common on food industry premises (Zuska and Laštovka 1965). Moreover, apart from decaying animal matter, its larvae have also been

recorded breeding on rotten leaves (Duda 1924). *Liopiophila* was described as a subgenus contained in genus *Piophilina* Fallén by Duda (1924), a classification which was followed by subsequent specialists (e.g. Hennig 1943; Zuska and Laštovka 1965). Nevertheless, McAlpine (1977) ranked *Liopiophila* as a genus containing a single species, *L. varipes*, transferring the rest of species included by Duda (1924) in subgenus *Liopiophila* to the genus *Prochyliza* Walker. On the other hand, Ozerov (2004) considered *Liopiophila* as a synonym of *Prochyliza*, including *L. varipes* in the latter genus.

The morphological descriptions of the immature stages of insects are necessary for the correct identification of species in those cases in which it is not possible to rear to adulthood. In the case of necrophagous insects, a reliable identification of the immature stages is essential from a forensic point of view. The larval morphology of most piophilid species remains unknown (Martín-Vega 2011) but curiously the mature larva of *L. varipes* has been described twice (Nielsen et al. 1954; Brindle 1965), although both descriptions contain controversial char-

acters. The current paper describes the morphology of the immature stages of *L. varipes*, providing simple diagnostic characters allowing for its differentiation from other Piophilidae species and comparing the characters of third-instar larva with those previous descriptions. Some considerations on the status of genus *Liopiophila* based on larval morphology are given.

## Material and methods

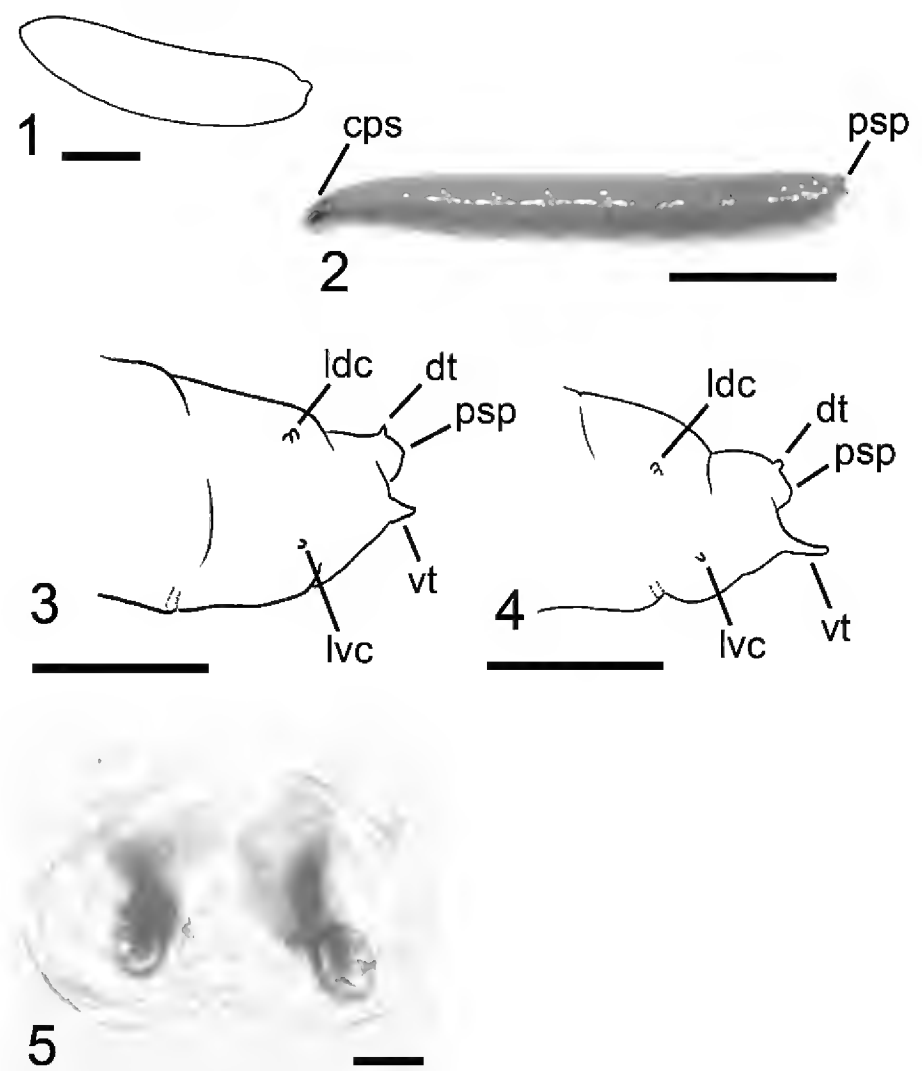
Adult flies of *L. varipes* were collected using pig carrion baits in a pine forest located in Puerto de Navafria (Madrid Province, central Spain) at 1810 m a.s.l. The flies were transferred to a plastic box of 230 × 155 × 115 mm with a gauze mesh at one side, and maintained at constant temperature (20 °C) and light photoperiod (12:12 h) inside a rearing camera. The flies were provided with water and granulated sugar cubes, as well as beef pâté which served as protein uptake to allow egg maturation and as substrate for oviposition. Plastic boxes were examined twice per day to trace whether females had spontaneously oviposited. Eggs were transferred to separate plastic tubs also containing beef pâté to feed emerging larvae, and sand to allow the burial and pupariation of post-feeding larvae. Plastic tubs were maintained in the same rearing camera with the adult colony.

First-instar larvae (L1), second-instar larvae (L2) and third-instar larvae (L3) were removed from the plastic tubs, killed in near-boiling water and then preserved in 80% ethanol. Twenty five L3 were measured within the first hour after killing and then preserved in 80% ethanol. Such killing and measuring procedure is recommended to minimize postmortem changes in larval length (Adams and Hall 2003). Twenty five eggs and puparia were also removed from the plastic tubs, directly measured and then preserved in 80% ethanol. Measurements of eggs were made under a light microscope equipped with a calibrated eyepiece micrometer; measurements of L3 and puparia were made under a binocular microscope with a micrometer and reticulated paper at ×8 magnification. L3 were clarified in hot 10% lactic acid, dissected and embedded in dimethyl hydantoin formaldehyde to study their different parts under a light microscope equipped with a camera lucida for drawings. Terminology follows Courtney et al. (2000) and Grzywacz et al. (2012). The studied material has been deposited in the collection of the Department of Life Sciences of the University of Alcalá.

## Results

### Egg

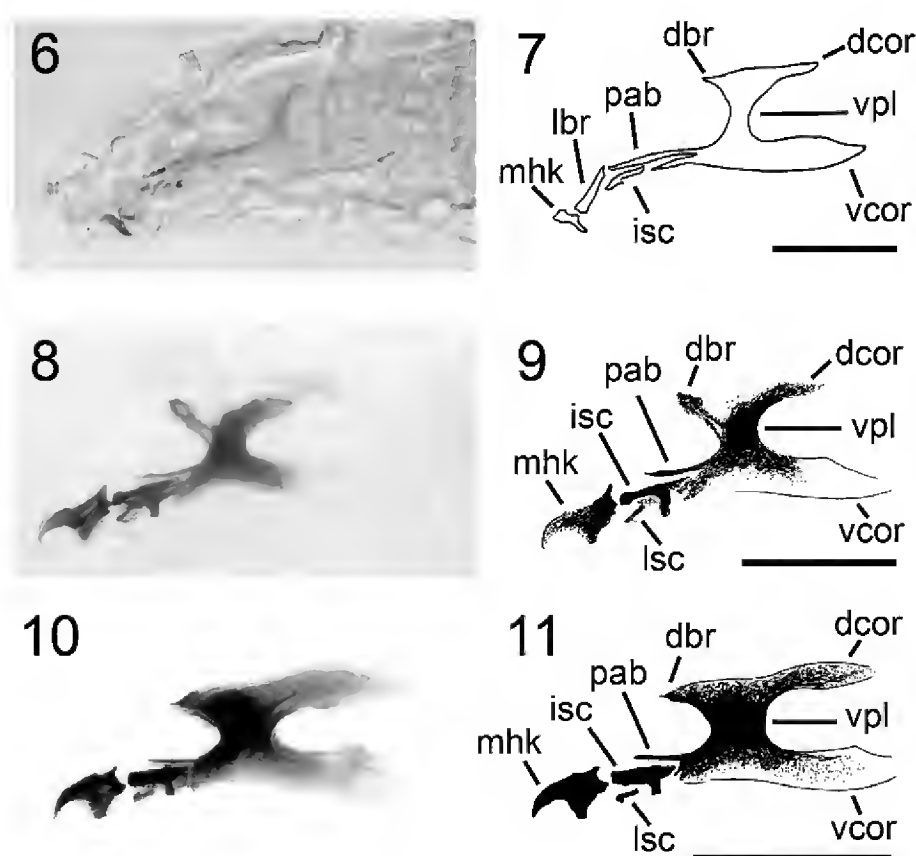
The eggs of *L. varipes* are white and long (mean length ± SD = 0.73 ± 0.03 mm; n = 25; range: 0.66–0.79), banana-shaped, with protuberant micropyle (Fig. 1), identical in general appearance to the eggs of other piophilid species (e.g. Hennig 1943, Martín-Vega et al. 2012).



**Figures 1–5.** Immature stages of *Liopiophila varipes* (Meigen) and *Stearibia nigriceps* (Meigen). **1.** Egg of *L. varipes*, scale bar 0.01 mm; **2.** Third-instar larva of *L. varipes*, scale bar 1.5 mm; **cps** – cephalopharyngeal skeleton; **psp** – posterior spiracle; **3.** Anal division of third-instar larva of *L. varipes*, lateral view, scale bar 0.5 mm; **4.** Anal division of third-instar larva of *S. nigriceps*, lateral view, scale bar 0.5 mm; **dt** – dorsal tubercles; **ldc** – laterodorsal cone; **lvc** – lateroventral cone; **psp** – posterior spiracle; **vt** – ventral tubercle; **5.** Posterior spiracles of *L. varipes*, scale bar 0.08 mm.

### Larva

The larvae of *L. varipes* show the typical morphology of the piophilid larvae; the body is cylindrical, tapering gradually forwards, narrowing slightly backwards and then somewhat truncated (Fig. 2). The mean length ± SD of L3 was 7.14 ± 0.42 mm (n = 25; range: 6.30–7.70). The body is divided in 12 segments (pseudocephalon, three thoracic segments, seven abdominal segments, and anal division); the anal division shows the typical morphology of piophilid larvae with a pair of dorsal tubercles and a longer pair of ventral tubercles (Figs 3, 4). A pair of posterior spiracles is placed on fleshy prominences below the dorsal tubercles. The posterior spiracles show slit-like openings (two openings in L1 and three openings in L2 and L3) on a sclerotized plate surrounded by the peritreme (Fig. 5), as typically described for Cyclorhapha larvae (Courtney et al. 2000). L3 showed the typical skipping behaviour observed in other species of Piophilidae by arching its body until the mouth hooks contact the anal tubercles, pulling and suddenly releasing them. The eleventh segment (i.e. seventh abdominal segment) shows two small pairs of laterodorsal and a small pair of lateroventral cones (Fig. 3).

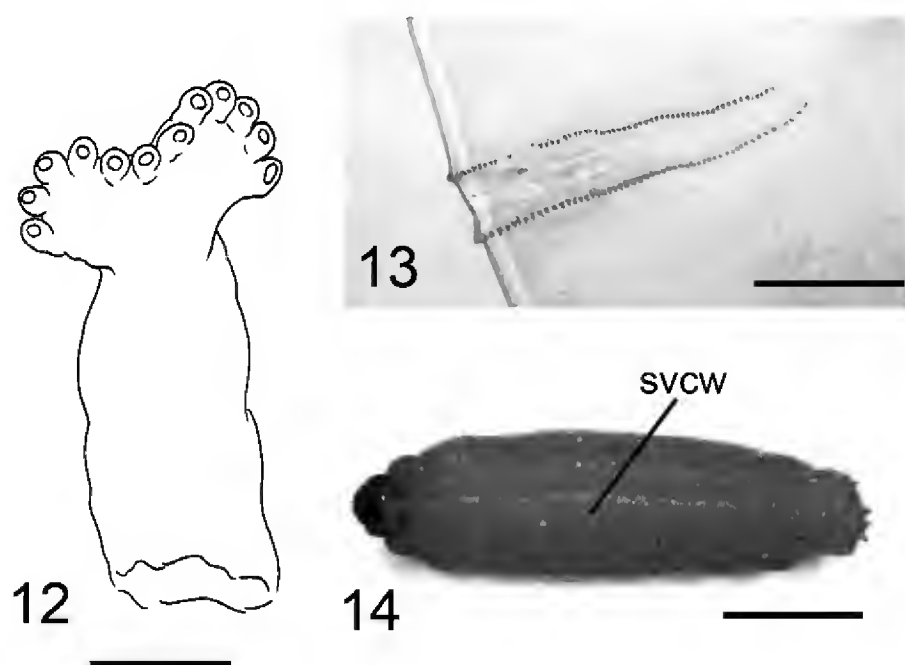


**Figures 6–11.** Cephalopharyngeal skeleton (CPS) of *Liopiophila varipes* (Meigen) larva. **6, 7** CPS of first-instar larva, scale bar 0.005 mm; **8, 9** CPS of second-instar larva, scale bar 0.1 mm; **10, 11** CPS of third-instar larva, scale bar 0.25 mm; **dbr** – dorsal bridge; **dcor** – dorsal cornua; **isc** – intermediate sclerite; **lbr** – labrum; **lsc** – labial sclerite; **mhk** – mouth hook; **pab** – parastomal bar; **vcor** – ventral cornua; **vpl** – vertical plate.

Pseudocephalon is bilobed and each lobe shows antennal organ and maxillary palpus as described by Courtney et al. (2000); antennal organs act as mechanoreceptors and olfactory receptors (Huckesfeld et al. 2010). The oral cavity shows a facial mask with oral comb plates surrounding the tips of the mouth hooks of cephalopharyngeal skeleton (hereafter CPS). In L1, the CPS is barely distinguishable, weakly sclerotized (Figs 6, 7) and very different from those of L2 and L3. In L2, the CPS is not completely sclerotized but clearly distinguishable (Figs 8, 9). The CPS of L3 is very similar to those of L2; its parts are well sclerotized and developed (Figs 10, 11). The dorsal edge of the CPS basal sclerite is convex, the dorsal and ventral cornua are long, and the dorsal bridge shows a broad base. The mouth hooks show a large base and their dorsal edge is slightly concave in its basal part (Figs 10, 11).

The first thoracic segment of L2 and L3 show a pair of anterior spiracles with fan-shaped arranged lobes at their distal edge (Fig. 12). The most frequent number of lobes of the anterior spiracles of L3 ranged from 10 to 12 ( $n = 10$ ); the lobes are arranged in two groups (of five or six, respectively) (Fig. 12). In L1, anterior spiracles were not distinguishable under light microscope; however, a pair of simple and minute prothoracic spiracles has been observed in the L1 of a range of Diptera Cyclorrhapha families under scanning electron microscope (see Grzywacz et al. 2012).

The abdominal segments of the larvae show ventral creeping welts equipped with two rows of spines (Fig. 13). The spines of the ventral creeping welts and the mouth hooks grip the substrate making possible the advance of the larvae into dead tissues (Roberts 1971).



**Figures 12–14.** Immature stages of *Liopiophila varipes* (Meigen). **12.** Anterior spiracle, scale bar 0.05 mm; **13.** Rows of spines on the ventral creeping welts, scale bar 0.15 mm; **14.** Puparium, ventral view, scale bar 1 mm; **svcw** – spines of the ventral creeping welts.

### Puparium

The puparium of *L. varipes* is barrel-shaped, brown to coppery red in colour (Fig. 14). The mean length  $\pm$  SD of the puparia was  $4.16 \pm 0.15$  mm ( $n = 25$ ; range: 3.8–4.4). Because the puparium of cyclorrhaphous flies is formed from the cuticle of L3 (Fraenkel and Bhaskaran 1973), cuticular features of the larvae, including the two rows of spines on the ventral creeping welts, can be observed in the puparia. Also, the CPS of L3 can be extracted from empty puparia and displayed.

### Discussion

Taking into account the economical interest of the larvae of the species of family Piophilidae (Zuska and Laštovka 1965), as well as the importance of careful and reliable identifications for their use in forensic entomology (Martín-Vega 2011), a complete larval identification key to this family would be desirable. A larval identification key to the genera of subtribe Piophilina is suggested below, following the classification of McAlpine (1977) and based on previous descriptions (Hennig 1943; McAlpine 1977; Ozerov 2000; Martín-Vega et al. 2012). Some characters from the key can be also observed on the puparia. Some characters need to be confirmed in genera *Arctopiophila* Duda, *Parapiophila* McAlpine and *Protopiophila* Duda; moreover, the considerations of Ozerov (2004) on the classification and validity of genera *Arctopiophila* and *Parapiophila* must be taken into account. For a general larval identification key to sarcosaprophagous Diptera families including Piophilidae see Velásquez et al. (2010). As mentioned, the larvae of most of the piophilid species remain undescribed and the scarce published descriptions are dispersed in the scientific literature, needing a compilation and updating. Further steps in these directions should be done.



### Key to the larvae of subtribe Piophilina *sensu* McAlpine (1977)

- 1 Ventral anal tubercles very short, apparently equal in length to the dorsal anal tubercles. Anterior spiracles with 6 lobes (unknown in *Arctopiophila*). Ventral creeping welts equipped with 6 rows of spines (unknown in *Arctopiophila* and *Protopiophila*). See Hennig (1943) for details on *Parapiophila vulgaris* (Fallén), McAlpine (1977) for details on *Arctopiophila arctica* (Holmgren), and Ozerov (2000) for details on *Protopiophila latipes* (Meigen) .....  
*Arctopiophila* Duda (2 spp.)  
*Parapiophila* McAlpine (15 spp.)  
*Protopiophila* Duda (11 spp.)
- Distinct combination of characters. Ventral creeping welts equipped with 2-3 rows of spines ..... 2
- 2 Ventral creeping welts equipped with 3 rows of spines ..... 3
- Ventral creeping welts equipped with 2 rows of spines ..... 4
- 3 Ventral anal tubercles slightly directed ventrally. Dorsal edge of mouth hook slightly convex in its basal part. Distance between the base and the tips of the mouth hook approximately equal than the width of the mouth hook base. See Martín-Vega et al. (2012) for details on *Prochyliza nigrimana* (Meigen) .....  
*Prochyliza* Walker (8 spp.)
- Ventral anal tubercles slightly directed posteriorly. Dorsal edge of the mouth hook slightly concave in its basal part. Distance between the base and the tips of the mouth hook approximately 1.3 times longer than the width of the mouth hook base. See Hennig (1943) and Martín-Vega et al. (2012) for details on *Piophila casei* (L.) .....  
*Piophila* Fallén (2 spp.)
- 4 Anterior spiracles with the lobes arranged in a single group. See McAlpine (1977) for details on *Lasiopiophila pilosa* .....  
*Lasiopiophila* Duda (1 sp.)
- Anterior spiracles with the lobes arranged in two groups ..... 5
- 5 Ventral anal tubercles elongated (Fig. 4). See Hennig (1943) for details on *Stearibia nigriceps* .....  
*Stearibia* Lioy (1 sp.)
- Ventral anal tubercles not elongated (Fig. 3). Cephalopharyngeal skeleton as in Figs 10 and 11 .....  
*Liopiophila* Duda (1 sp.)

### Identification of the larva described by Nielsen et al. (1954) as *L. varipes*

The current description of *L. varipes* L3 fits with the description provided by Nielsen et al. (1954) for larvae collected on the bones of a whale. The morphology of the CPS of the L3 figured by Nielsen et al. (1954), with the convex dorsal edge of the basal plate, the broad base of the dorsal bridge, and the large base of mouth hooks, strongly resembles the CPS of *L. varipes* (Figs 10, 11). Moreover, Nielsen et al. (1954) figured a fan-shaped anterior spiracle with ten lobes arranged in two groups of five, as well as two rows of spines on the ventral creeping welts; these characters match with those observed in the current study (Figs 12, 13). Nielsen et al. (1954) suggested that the described larva may belong to *L. varipes* or to *Prochyliza lundbecki* (Duda), justifying their decision in the presence of two rows of ventral creeping welts which ‘should, according to the key in Hennig (1943), belong to the subgenus *Liopiophila*’ (sic). However, in his larval identification key, Hennig (1943) differentiated the ‘*Piophila*-*Liopiophila* group’ by the presence of three rows of spines on the ventral creeping welts. Hennig (1943) justified such affirmation in the characters of the larva of *Piophila casei* (L.). Hence, the identification of the described larva as *L. varipes* by Nielsen et al. (1954) was very likely due to a misinterpretation of the key of Hennig (1943), but paradoxically they appeared to be right in their decision.

### Spiracles as diagnostic character for identifying *L. varipes* larvae

In his larval identification key, Brindle (1965) suggested as diagnostic characters of *L. varipes* the fan-shaped an-

terior spiracles with six lobes arranged in a single group and the pair of ventral anal tubercles directed ventrally. The orientation of the anal tubercles is a character which should be taken with caution because differences in this sense are not always easily distinguishable (Martín-Vega et al. 2012). On the other hand, the anterior spiracle figured by Brindle (1965) does not fit with the description of Nielsen et al. (1954) and with the current observations (Fig. 12). The larvae of most piophilid species show fan-shaped anterior spiracles with the lobes arranged in a single group (Hennig 1943; Martín-Vega et al. 2012). Furthermore, the lobes of the anterior spiracles of *L. varipes* are thick, crowded together in the distal, fan-shaped part of the anterior spiracle (Fig. 12). Such character was also noted by Nielsen et al. (1954). The anterior spiracles of the larvae of other piophilid species show different appearance; the lobes are thin and arranged more separately from each other (Hennig 1943; Martín-Vega et al. 2012).

### Validity of the genus *Liopiophila* and systematics of Piophilidae

McAlpine (1977) suggested a phylogeny of the Piophilidae where the genera *Lasiopiophila* Duda, *Liopiophila*, *Stearibia* Lioy, *Piophila*, and *Prochyliza* form a monophyletic group sharing the following characters: a weak or absent outer postpronotal bristle, the male abdomen sternites divided and the seventh male sternite frequently bearing peg-like processes. Moreover, the four latter genera share the loss of outer postpronotal bristle and the reduction of hairiness, with *Liopiophila* being the sister group of *Stearibia*, and *Piophila* the sister group of *Prochyliza* (McAlpine 1977). McAlpine (1977) con-



sidered *Piophila* and *Prochyliza* as sister groups because of the presence of secondary male characters, but no apomorphy was suggested for the group formed by *Liopiophila* and *Stearibia*. Nevertheless, McAlpine (1977) described the genus *Liopiophila* as very similar in most respects to *Stearibia*, with the presence of setae on the anepimeron being the differential character of *Liopiophila*. In his fine discussion on the classification of the Piophilidae, Ozerov (2004) recognized this character as a unique characteristic of *L. varipes*, but he did not consider it sufficient to distinguish this species as a separated genus and suggested including it in the genus *Prochyliza*. The suggestion of Ozerov (2004) was based on the presence of a silvery-white strip of pubescence on the gena as characteristic of all those species.

The larval morphology of *L. varipes* supports, however, the phylogeny and classification suggested by McAlpine (1977), and therefore the validity of genus *Liopiophila*. The arrangement of thick lobes of the anterior spiracles in two groups is characteristic of the larvae of *L. varipes* (Fig. 12), but is identical in the larvae of *Stearibia nigriceps* (Meigen) (Hennig 1943). It must be mentioned that Hennig (1943) described the morphology of the CPS and anterior spiracles of *S. nigriceps* (named as *Piophila foveolata* Meigen) larvae from the characters observed on a puparium of this species, highlighting that the number of rows of spines on the ventral creeping welts could not be confirmed from such a specimen. The first author of the current manuscript has studied some larvae of *S. nigriceps* collected in a carrion-succession study (see Anton et al. 2011) which showed two rows of spines on the ventral creeping welts. The presence of two rows of spines on the ventral creeping welts is therefore a common character of both *L. varipes* and *S. nigriceps*, but it is also shown by the larva of *Lasiopiophila pilosa* (Staeger), which conversely show anterior spiracles with lobes arranged in a single group (McAlpine 1977). In the group formed by *Piophila* and *Prochyliza* the lobes of the anterior spiracles are also arranged in a single group (Hennig 1943; Martín-Vega et al. 2012), but with the ventral creeping welts being equipped with three rows of spines (Hennig 1943; Martín-Vega et al. 2012). Finally, the larvae of *L. varipes* and *S. nigriceps* can be differentiated by the morphology of the pair of ventral tubercles, which are distinctly more elongate in *S. nigriceps* (Figs 3, 4).

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## References

- Adams ZJO, Hall MJR (2003) Methods used for the killing and preservation of blowfly larvae, and their effect on post-mortem larval length. *Forensic Science International* 138: 50–61. doi: 10.1016/j.forsciint.2003.08.010
- Anton E, Niederegger S, Beutel RG (2011) Beetles and flies collected on pig carrion in an experimental setting in Thuringia and their forensic implications. *Medical and Veterinary Entomology* 25: 353–364. doi: 10.1111/j.1365-2915.2011.00975.x
- Brindle A (1965) Taxonomic notes on the larvae of British Diptera No. 21—the Piophilidae. *The Entomologist* 78: 158–160.
- Courtney GW, Sinclair BJ, Meier R (2000) Morphology and terminology of Diptera larvae. In: Papp L, Darvas B (Eds) *Contribution to a manual of Palearctic Diptera* (with special reference to flies of economic importance), vol. 1. Science Herald Press, Budapest, 85–161.
- Duda O (1924) Revision der europäischen u. grönländischen sowie einiger südasiatischer Arten der Gattung *Piophila* Fallén (Dipteren). *Konowia* 3: 97–113, 153–203.
- Fraenkel G, Bhaskaran G (1973) Pupariation and pupation in cyclorhaphous flies (Diptera): Terminology and interpretation. *Annals of the Entomological Society of America* 66: 418–422.
- Grzywacz A, Pape T, Szpila K (2012) Larval morphology of the lesser housefly, *Fannia canicularis*. *Medical and Veterinary Entomology* 26: 70–82. doi: 10.1111/j.1365-2915.2011.00968.x
- Hennig W (1943) Piophilidae. In: Lindner E (Ed) *Die Fliegen der Palaearktischen Region*, vol. 5. Schweizerbart, Stuttgart, 1–52.
- Hucklesfeld S, Niederegger S, Heinzel HG, Spieß R (2010) The cephalic and pharyngeal sense organs of *Calliphora vicina* 3rd instar are mechanosensitive but have no profound effect on ongoing feeding related motor patterns. *Journal of Insect Physiology* 56: 1530–1541. doi: 10.1016/j.jinsphys.2010.05.004
- Martín-Vega D (2011) Skipping clues: Forensic importance of the family Piophilidae. *Forensic Science International* 212: 1–5. doi: 10.1016/j.forsciint.2011.06.016
- Martín-Vega D, Baz A (2013) Sarcosaprophagous Diptera assemblages in natural habitats in central Spain: spatial and seasonal changes in composition. *Medical and Veterinary Entomology* 27: 64–76. doi: 10.1111/j.1365-2915.2012.01028.x
- Martín-Vega D, Baz A, Díaz-Aranda LM (2012) The immature stages of the necrophagous fly, *Prochyliza nigrimana*: comparison with *Piophila casei* and medicolegal considerations (Diptera: Piophilidae). *Parasitology Research* 111: 1127–1135. doi: 10.1007/s00436-012-2943-5
- McAlpine JF (1977) A revised classification of the Piophilidae, including ‘Neottiophilidae’ and ‘Thyreophoridae’ (Diptera: Schizophora). *Memoirs of the Entomological Society of Canada* 103: 1–66. doi: 10.4039/entm109103fv

- Nielsen P, Ringdahl O, Tuxen SL (1954) Diptera 1 (exclusive of Ceratopogonidae and Chironomidae). The Zoology of Iceland 3: 1–189.
- Ozerov AL (2000) Family Piophilidae. In: Papp L, Darvas B (Eds) Contribution to a manual of Palearctic Diptera (with special reference to flies of economic importance), Appendix. Science Herald Press, Budapest, 355–365.
- Ozerov AL (2004) On the classification of the family Piophilidae. Entomological Review 84: 600–608.
- Roberts MJ (1971) On the locomotion of cyclorrhaphan maggots (Diptera). Journal of Natural History 5: 583–590. doi: 10.1080/00222937100770421
- Velásquez Y, Magaña C, Martínez-Sánchez A, Rojo S (2010) Diptera of forensic importance in the Iberian Peninsula: larval identification key. Medical and Veterinary Entomology 24: 293–308.
- Zuska J, Laštovka P (1965) A review of the Czechoslovak species of the family Piophilidae with special reference to their importance to food industry (Diptera, Acalyptrata). Acta Entomologica Bohemoslovaca 62: 141–157.
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# A review of the genus *Oosternum* Sharp of the West Indies (Coleoptera: Hydrophilidae: Sphaeridiinae)

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## Abstract

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## Key Words

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Neotropical Region

The representatives of the genus *Oosternum* Sharp, 1882 occurring in the West Indies are revised. Ten species are recorded, of which seven are here described as new: *Oosternum andersoni* sp. n. (Cuba), *O. bacharengae* sp. n. (Dominican Republic), *O. cercyonoides* sp. n. (Jamaica), *O. insulare* sp. n. (Jamaica), *O. luciae* sp. n. (Saint Lucia), *O. megnai* sp. n. (Cuba) and *O. pecki* sp. n. (Dominican Republic). Diagnoses and detailed distributional data are also provided for *O. sharpi* Hansen, 1999 (widespread throughout both Greater and Lesser Antilles), *O. latum* Fikáček, Hebauer & Hansen, 2009 (endemic to St. Vincent) and an undescribed species from the Bahamas. A key to the West Indian *Oosternum* is provided and important diagnostic characters are illustrated. The West Indian fauna of *Oosternum* contains representatives of five different species groups and likely originated by multiple independent colonizations from the American continent. Within the study region, the highest diversity is known from the Greater Antilles, where two endemic species each in Cuba, Jamaica, and Hispaniola. The populations of *O. sharpi* were found to consist exclusively of females on all islands with the exception Puerto Rico.

## Introduction

The West Indies (i.e. the Caribbean islands off the continental shelf; Bond 1993) is a region generally known for its high species diversity and endemism. At the same time, large part of its natural habitats were destroyed and it is therefore considered as one of the world's biodiversity hotspots (Mittermeier et al. 2005). Although a large number of biodiversity studies have been conducted in the area, surprisingly little is known about the diversity of insects and other invertebrates. Cryptic leaf-litter inhabiting taxa are among those for which available information is especially limited, although a very high diversity

is expected based on available data from the continental Central America (e.g., Anderson and Ashe 2000) and preliminary data available from several projects currently running in the Caribbean islands (e.g., Cala-Riquelme 2013; Cala-Riquelme and Agnarsson in press; Deler-Hernández et al. 2013; R. Anderson, pers. comm.).

In the present contribution we examine the West Indian fauna of the hydrophilid beetle genus *Oosternum* Sharp, 1882. The genus contains minute beetles generally inhabiting leaf-litter of various types of tropical forests. Although it also occurs in the Oriental Region, the genus is especially diverse in the Neotropical Region, from where 15 species are presently described (Fikáček 2009;

Fikáček and Hebauer 2009; Fikáček et al. 2009; Makhan 2009; Short and Fikáček 2011) and additional ca. 45 species are awaiting description (M. Fikáček unpubl. data). Based on the distribution data of the species groups which were already revised in detail (see aforementioned references), the genus includes both widely distributed species as well as those with very limited ranges, and seems therefore an ideal model group to study the biogeography and endemism of the leaf-litter invertebrates of the West Indian islands. This motivated us to perform its detailed taxonomic revision.

Available data from the West Indies were very scarce prior to this study. A single widespread species, *O. sharpi* Hansen, 1999, was recorded from Cuba and Puerto Rico (Peck 2005; Spangler 1981, in both cases as *O. costatum* Sharp, 1882) and the supposed single island endemic *O. latum* Fikáček, Hebauer & Hansen, 2009 was described recently from the Saint Vincent Island of the Lesser Antilles (Fikáček et al. 2009). For this study we have accumulated the material from 15 islands of both the Greater and Lesser Antilles, resulting from our own recent field work in Cuba and Jamaica and from several large projects by the Canadian and US entomologists. The results of the taxonomic revision of this material are summarized below.

Materials and methods

A total of 280 specimens from 13 countries (15 islands) of the West Indies were examined in this study. Most specimens were collected by sifting leaf litter in various kinds of forests with subsequent extraction using Berlese funnels and Winkler traps. Part of this material was collected during our recent expeditions to various parts of Cuba and Jamaica. The remaining material was examined from the Canadian and US collections, most importantly the personal collection of Professor Stewart Peck (SBPC) and the West Indian Beetle Fauna Project Collection (WICF).

Habitus photographs were taken using Canon EOS 550D digital camera with attached Canon MP-E65mm f/2.8 1–5× macro lens, and subsequently adapted in Adobe Photoshop CS5. Drawings of male genitalia are based on

photographs taken using Canon EOS 1100D digital camera attached to Olympus BX41 compound microscope and subsequently combined in Helicon Focus software. Scanning electron micrographs of the holotypes of the new species were taken using Hitachi S-3700N environmental electron microscope at the Department of Paleontology, National Museum in Prague. General morphological terminology follows Hansen (1999) and Fikáček et al. (2009).

Examined specimens are deposited in the following collections:

- BMNH The Natural History Museum, London, U.K. (M. Barclay);
- BSC-E Departamento de Zoología, Centro Oriental de Ecosistemas y Biodiversidad, Santiago de Cuba, Cuba (F. Cala-Riquelme);
- CMN Canadian Museum of Nature, Ottawa, Canada (R. Anderson);
- CNC Canadian National Collection, Ottawa, Canada (A. Smetana);
- NMPC National Museum, Prague, Czech Republic (M. Fikáček);
- SBPC Stewart Peck Personal Collection, Ottawa, Canada;
- SEMC Division of Entomology, Biodiversity Institute, University of Kansas, Lawrence, USA (A. Short);
- WIBF West Indian Beetle Fauna Project Collection, Montana State University, Bozeman, Montana (M. Ivie).

Checklist of the West Indian species of *Oosternum*

<i>Oosternum andersoni</i> sp. n. ....	Cuba
<i>Oosternum bacharenge</i> sp. n. ....	Hispaniola: Dominican Rep.
<i>Oosternum cercyonoides</i> sp. n. ....	Jamaica
<i>Oosternum insulare</i> sp. n. ....	Jamaica
<i>Oosternum latum</i> Fikáček, Hebauer & Hansen, 2009 .....	Saint Vincent
<i>Oosternum luciae</i> sp. n. ....	Saint Lucia
<i>Oosternum megnai</i> sp. n. ....	Cuba
<i>Oosternum pecki</i> sp. n. ....	Hispaniola: Dominican Rep.
<i>Oosternum sharpi</i> Hansen, 1999.....	widespread in the West Indies
<i>Oosternum</i> sp. ....	Bahamas: Andros Is.

Key to species of West Indian *Oosternum*

- 1 Median portion of prosternum elevated and demarcated from lateral portions (Figs 35–38). Antennal grooves of prothorax with acute lateral projection (see Fikáček 2009, Fig. 13) ..... 2
- Median portion of prosternum not elevated and demarcated from lateral portions (Figs 29–33). Antennal grooves of prothorax rounded to subangular, without acute lateral projection ..... 5
- 2 Pronotal punctation consisting of punctures of two very different sizes (Figs 22, 27). Each paramere bearing a single seta apically (Figs 55, 60) ..... 3
- Pronotal punctation uniform, all punctures of the same size (Figs 23, 24). Each paramere bearing two short setae apically (Figs 56, 57) ..... 4
- 3 Pronotum without microsculpture on interstices (Fig. 22). Metaventricle crenulate behind mesocoxal cavities (Fig. 42). Lateral membrane in apical portion of the median lobe very narrow and without setae (Fig. 55) ..... *O. insulare*

- Pronotum with fine mesh-like microsculpture on interstices (Fig. 27). Metaventrite not crenulate behind mesocoxal cavities (Fig. 47). Lateral membrane in apical portion of the median lobe wide and with a series of fine setae (Fig. 60)..... *O. sharpi*
- 4 Body widest at elytral base (Fig. 9). Pronotum very convex, not forming a continuous curve with elytra in lateral view (Fig. 10). Lateral membrane only present in apical fifth of the median lobe and lacking setae (Fig. 56) ..... *O. latum*
- Body widest ca at midlength (Fig. 11). Pronotum moderately convex, forming a continuous curve with elytra in lateral view (Fig. 12). Lateral membrane reaching midlength of the median lobe and bearing a series of fine setae (Fig. 57) ...  
..... *O. luciae*
- 5 Punctures of pronotum increasing in size towards posterior margin, smaller and transverse anteriorly and large and rounded posteriorly (Fig. 26). Preepisternal plate of mesoventrite subrhomboid, largely overlapping over anterior portion of the metaventrite (Fig. 46). Aedeagus as in Fig. 59..... *O. pecki*
- Pronotal punctation uniform, size of punctures not increasing posteriad. Preepisternal plate of mesoventrite drop-like or suboval, only slightly overlapping over the anterior margin of the metaventrite (Figs 39–41, 45)..... 6
- 6 Elytral interval 2 narrower and lower than interval 3 subapically. Preepisternal elevation of the mesothorax narrower, 2.0–2.8× as long as wide. Smaller species, body length smaller than 1.5 mm..... 7
- Elytral interval 2 of the same width and height as interval 3 subapically. Preepisternal elevation of the mesothorax wide, 1.7× as long as wide. Large species, body length 1.9–2.0 mm ..... *O. cercyonoides*
- 7 Anterolateral ridges of metaventrite meeting mesally and projecting posteriad (Fig. 40). Apical portion of the median lobe bottle-shaped, widely rounded at apex (Fig. 54). General coloration dark brown (Figs 3, 4)..... *O. bacharenge*
- Anterolateral ridges of metaventrite not meeting mesally (Figs 39, 45). Apical portion of the median lobe gradually narrowing, acute at apex (Figs 53, 58)..... 8
- 8 Lateral margin of the pronotum sinuate. Preepisternal elevation of mesoventrite wider, 2.0× as long as wide (Fig. 39). Median lobe very wide, not reaching the level of parameral apices (Fig. 53) ..... *O. andersoni*
- Lateral margin of the pronotum arcuate. Preepisternal elevation of mesoventrite narrower, 2.3× as long as wide (Fig. 45). Median lobe narrow, slightly overlapping the parameral apices (Fig. 58)..... *O. megnai*

## Taxonomy

### *Oosternum andersoni* sp. n.

<http://zoobank.org/FEFF4A2B-C113-4209-8551-25BE9943D63D>

[http://species-id.net/wiki/Oosternum\\_andersoni](http://species-id.net/wiki/Oosternum_andersoni)

Figs 1–2, 19, 29, 39, 53, 61

**Type-locality.** Cuba, Santiago de Cuba Province: Santiago Municipality, 20.011°N, 75.673°W, 550 m, Km 7 of the road to Gran Piedra.

**Type-specimens** (144 spec.). Holotype male, dry mounted, with genitalia mounted in Euparal on a microslide pinned below the specimen. Original label: “CUBA: Santiago de Cuba: Km 7 of the road to Gran Piedra, 26.i.2012, R. Anderson leg., 20.011°N, 75.673°W, elevation 550 m [printed] / Holotype, *Oosternum andersoni* sp. n., Deler-Hernández & Fikáček det. 2013 [red, printed]” (NMPC). Paratypes: **CUBA:** Pinar del Río province, Sierra del Rosario, Rangel, ca. 15 Km S. Cinco Pesos, 30.v.1990, M. A. Ivie leg., berlese from deep log and leaf litter (2 spec., WIFP). Cienfuegos province: Cumanayagua municipality, 2 Km E of Mayarí, ca. 842 m a.s.l., 21.96651°N, 80.11497°W, 18.v.2013, R. Anderson leg (2013-017) (29 spec., NMPC); Cumanayagua municipality, uphill road to Pico San Juan, ca. 1086 m a.s.l., 21.9881°N, 80.1464°W, 19.v.2013, R. Anderson leg (2013-022) (37 spec., NMPC); Cumanayagua municipality, Aguacate, Gruta Mengoa, near of Río Cabagan, ca. 620 m a.s.l., 21°55'52.43"N, 80°5'4.60"W, 20.v.2013, R. Anderson & A. Deler-Hernández leg (CF6) (53 spec., NMPC, CMN, BMNH, SEMC, SBPC). Holguín

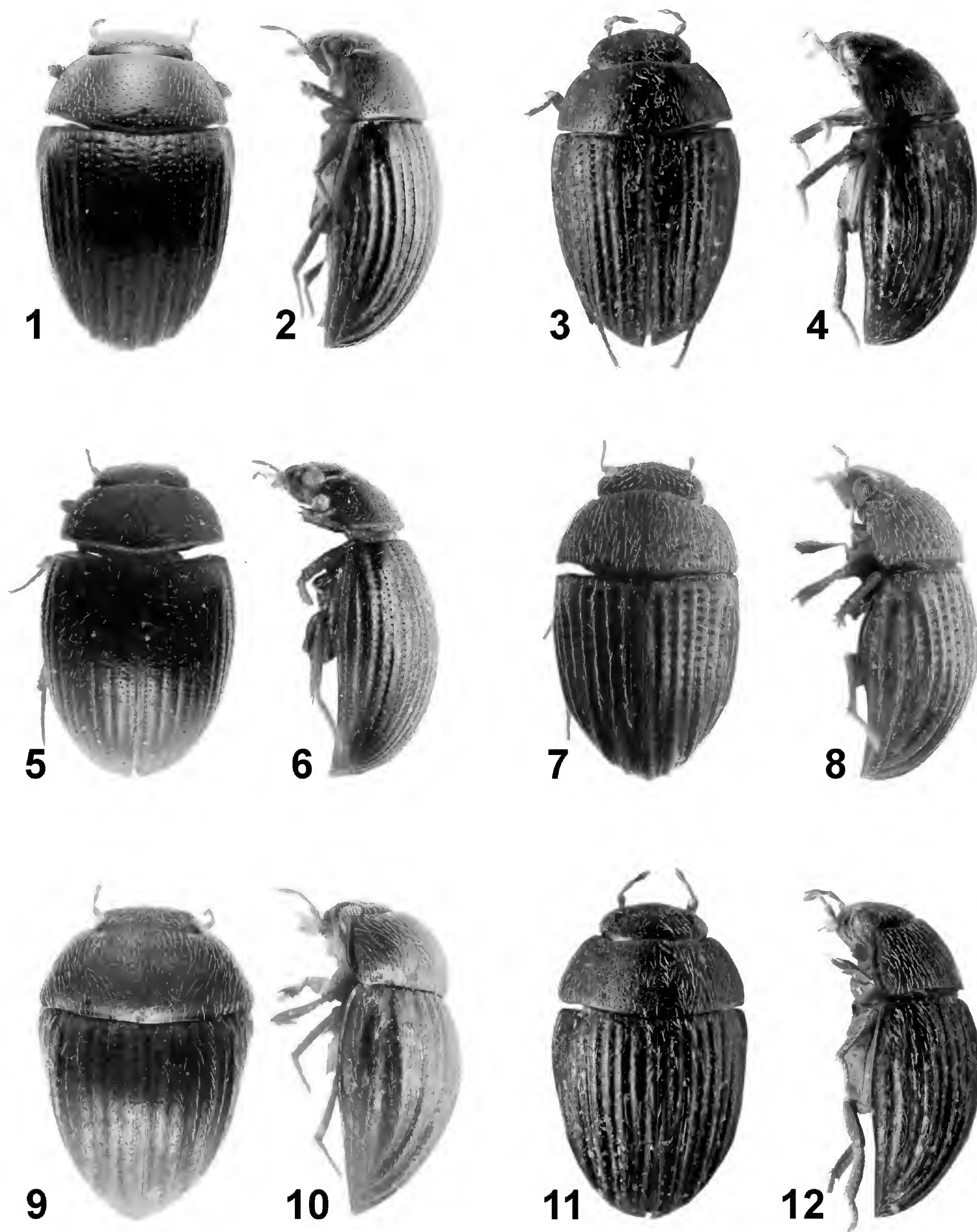
province: Mayarí municipality, Pinarito, PN La Mensura-Piloto, ca. 410 m a.s.l., 20.41598°N, 75.82008°W, 12.v.2013, R. Anderson leg (13 spec., NMPC). Santiago de Cuba province: Km 7 of the road to Gran Piedra, ca. 550 m a.s.l., 20.011°N, 75.673°W, 26.i.2012, R. Anderson leg. (2012-007) (5 spec., BSC-E, NMPC); 23.v.2013, R. Anderson leg. (2013-031) (4 spec., NMPC).

**Differential diagnosis.** Body widest ca at midlength. Lateral margin of pronotum weakly sinuate. Pronotal punctation uniform in size, moderately dense, consisting of small, rasp-like punctures. Pronotal interstices without microsculpture. Mesal part of prosternum not divided from lateral portions. Lateral margin of antennal grooves rounded. Elytral interval 2 narrower than interval 3, lower than intervals 1 and 3, reaching elytral apex. Elytral intervals 5, 7 and 9 distinctly higher than adjacent intervals. Elytral interstices shiny, without microsculpture. Preepisternal plate wide, drop-like, 2× longer than wide. Interstices of median part of metaventrite without microsculpture. Anterolateral ridges of metaventrite not meeting together mesally. Parameres 1.2× longer than phallobase, bearing two short setae apically. Median lobe shorter than parameres, widely oval in shape, acute at apex. Membranous lateral projections of median lobe absent.

**Description. Habitus.** Body elongate oval, gradually narrowing posteriad; total length/total width ratio = 1.7. Length: 1.25–1.29 mm, length of holotype: 1.37 mm; width: 0.73–0.77 mm, width of holotype: 0.75 mm.

**Coloration.** Coloration of dorsal side brown to dark brown, elytra darker than pronotum, head dark brown. Ventral side brown. Femora and tibiae brown, tarsi,





**Figures 1–12.** Habitus of *Oosternum* from West Indies. **1–2.** *Oosternum andersoni* sp. n., length = 1.25 mm (1. dorsal view, 2. lateral view). **3–4.** *Oosternum bacharenge* sp. n., length = 1.40 mm (3. dorsal view, 4. lateral view). **5–6.** *Oosternum cercyonoides* sp. n., length = 1.95 mm (5. dorsal view, 6. lateral view). **7–8.** *Oosternum insulare* sp. n., length = 1.40 mm (7. dorsal view, 8. lateral view). **9–10.** *Oosternum latum* Fikáček, Hebauer & Hansen, 2009, length = 1.50 mm (9. dorsal view, 10. lateral view). **11–12.** *Oosternum luciae* sp. n., length = 1.41 mm (11. dorsal view, 12. lateral view).



antennomeres 1–6 and mouthparts yellowish, antennal club pale reddish brown.

**Head.** Clypeus with sparse punctation consisting of fine rounded punctures, each puncture bearing fine decumbent seta; setae pale; interstices without microsculpture; anterior margin of clypeus slightly concave. Frons with dense punctation consisting of coarse rounded punctures, punctures of same shape medially and laterally; interstices with fine mesh-like microsculpture. Eyes moderately large. Mentum  $1.8\times$  wider than long, anterior margin slightly emarginate; anteromedian part not distinctly impressed; with sparse punctation, punctation consisting of minute, nearly indistinct punctures bearing minute setae; interstices with very fine microsculpture, opaque. Submentum without poriferous disc-like fields. Maxillary palpus with palpomeres 2 and 4 ca.  $1.5\times$  longer than palpomere 3. Antenna with 9 antennomeres; scapus shorter than antennomeres 2–6 combined.

**Prothorax.** Pronotum evenly convex forming continuous curve with elytra in lateral view. Lateral margin weakly sinuate; with narrow marginal bead. Pronotal punctation uniform in size, moderately dense; slightly sparser than that on frons, consisting of small, rasp-like punctures, slightly sparser laterally than medially; all punctures bearing long setae; interstices without microsculpture. Transverse row of punctures on posterior margin of pronotum absent. Median portion of prosternum not elevated and demarcated from lateral portions, median carina of prosternum narrow, projecting more anteriorly mesally than anterior margin of median portion, with anterior portion elevated into small tooth in lateral view. Postero-mesal projection with deep notch. Antennal grooves moderately large. Lateral margin of antennal grooves rounded.

**Mesothorax.** Scutellar shield bearing a few small punctures; interstices without microsculpture. Elytral series 1–5 arising basally, series 6–9 joint subbasally. Serial punctures small, transverse, sparsely arranged, with minute setae (indistinct under binocular microscope). Interval 2 narrower than interval 3, lower than intervals 1 and 3, reaching elytral apex, intervals 5, 7 and 9 distinctly higher than adjacent intervals. Elytral interstices shiny, without microsculpture. Preepisternal plate wide, drop-like,  $2\times$  longer than wide, widely attached to metaventricle; posterior part of preepisternal elevation slightly overlapping over anterior margin of metaventricle; median part flat; bearing sparsely arranged shallow setiferous punctures; interstices without microsculpture.

**Metathorax.** Metaventricle distinctly longer than preepisternal elevation of mesothorax, median portion markedly differing from lateral portion in punctation and microsculpture; punctation of median portion consisting of small rounded punctures, interstices without microsculpture, shiny. Anterolateral ridges bent posteriad along lateral margin of metaventricle, concave laterally, not meeting together and bent posteriad mesally. Anterior margin of metaventricle not crenulate.



**Figures 13–18.** Habitus of *Oosternum* from West Indies. **13–14.** *Oosternum megnai* sp. n., length = 1.49 mm (13. dorsal view, 14. lateral view). **15–16.** *Oosternum pecki* sp. n., length = 1.50 mm (15. dorsal view, 16. lateral view). **17–18.** *Oosternum sharpi* Hansen, 1999, length = 1.37 mm (17. dorsal view, 18. lateral view).

**Abdomen.** Ventrite 1 with additional longitudinal ridges laterally. Ventrites 2–5 without longitudinal ridges; posterior margin of all ventrites lacking denticles.

**Male genitalia.** Aedeagus 0.5 mm long, parameres 1.2× longer than phallobase. Parameres continuously narrowing apicad, bearing two short setae apically. Phallobase wide, 1.4× longer than wide. Median lobe slightly shorter than parameres, widely oval in shape, slightly narrowing at apex. Membranous lateral projections of median lobe absent. Gonopore absent.

**Etymology.** The new species is dedicated to our friend Robert S. Anderson (Canadian Museum of Nature, Ottawa), a very enthusiastic entomologist and collector of the type specimens.

**Distribution.** *Oosternum andersoni* sp. n. is a Cuban endemic species currently known from the western, central and eastern parts of the island (Fig. 61).

**Habitat.** Most specimens were sifted from wet leaf litter in evergreen montane forests.

### *Oosternum bacharenge* sp. n.

<http://zoobank.org/AFDE881F-D1DB-419C-874D-C373DC6E36B7>

[http://species-id.net/wiki/Oosternum\\_bacharenge](http://species-id.net/wiki/Oosternum_bacharenge)

Figs 3–4, 20, 30, 40, 54, 61

**Type-locality.** Dominican Republic, Hatomayor province: Parque Nacional Los Haitises, 19°1'4.26"N, 69°37'17.24"W, 250 m, W of Sabana de la Mar.

**Type-specimens** (1 spec.). Holotype dry mounted, with genitalia mounted in Euparal on a microslide pinned below the specimen. Original label: “DOM REP: Hatomayor province, Par. Nac. Los Haitises W. of Sabana de la Mar, 01.iv.1992, M. A. Ivie, D. S. Sikes & W. Lanier, 19°1'4.26"N, 69°37'17.24"W, elevation 250 m, [printed] / Holotype, *Oosternum bacharenge* sp. n., Deler-Hernández & Fikáček det. 2013 [red, printed]” (WIFP).

**Diagnosis.** Body widest ca. at midlength. Lateral margin of pronotum angulate. Pronotal punctation uniform in size, moderately dense consisting of small rasp-like punctures. Pronotal interstices without microsculpture. Mesal part of prosternum not divided from lateral portions. Lateral margin of antennal grooves rounded. Elytral interval 2 narrower than interval 3, lower than intervals 1 and 3, reaching elytral apex. Elytral intervals 5, 7 and 9 as convex as adjacent intervals. Elytral interstices shiny, without microsculpture. Preepisternal plate narrow, suboval, 2.8× longer than wide. Interstices of median part of metaventrite without microsculpture, shiny. Anterolateral ridges of metaventrite meeting together and bent posteriad mesally. Parameres 0.8× as long as phallobase, bearing two short setae apically. Median lobe ca. as long as parameres, nearly parallel-sided, bottle-shaped apically. Membranous lateral projections of median lobe absent.

**Description. Habitus.** Body elongate oval, gradually narrowing posteriad; total length /total width ratio = 1.6. Length: 1.4 mm; width: 0.84 mm.

**Coloration.** Coloration of dorsal side of head, pronotum and elytra dark brown. Ventral side brown.

**Head.** Clypeus with sparse punctation consisting of fine punctures, each puncture bearing fine decumbent seta; setae pale; interstices without microsculpture; anterior margin of clypeus slightly concave. Frons with moderately dense punctation, consisting of coarse, crescent-like punctures, punctures of same shape medially and laterally; interstices without microsculpture. Eyes moderately large. Mentum 1.8× wider than long, anterior margin slightly emarginate; anteromedian part not distinctly impressed; with sparse punctation consisting of small and isolated, nearly indistinct punctures bearing minute setae; interstices with very fine microsculpture, opaque. Submentum without poriferous disc-like fields. Maxillary palpus with palpomeres 2 and 4 ca. 1.5× longer than palpomere 3. Antenna with 9 antennomeres; scapus shorter than antennomeres 2–6 combined.

**Prothorax.** Pronotum evenly convex forming continuous curve with elytra in lateral view. Lateral margin of pronotum angulate, with narrow marginal bead. Pronotal punctation uniform in size, moderately dense, slightly denser than that on frons, consisting of small, rasp-like punctures similar on whole surface of pronotum; all punctures bearing long setae; interstices without microsculpture. Median portion of prosternum not elevated and demarcated from lateral portions, median carina of prosternum narrow, projecting more anteriad mesally than anterior margin of median portion, with anterior portion elevated into small tooth in lateral view. Postero-mesal projection with deep notch. Antennal grooves moderately large. Lateral margin of antennal grooves rounded.

**Mesothorax.** Scutellar shield bearing a few tiny punctures; interstices without microsculpture. Elytral punctures coarse, shallowly impressed, rounded to slightly transverse. Serial punctures small; transverse; sparsely arranged, with minute setae (indistinct under binocular microscope). Interval 2 narrower than interval 3, lower than intervals 1 and 3, reaching elytral apex, intervals 5, 7 and 9 as convex as adjacent intervals. Elytral interstices shiny, without microsculpture. Preepisternal plate narrow, suboval, 2.8× longer than wide, widely attached to metaventrite; posterior part of preepisternal elevation slightly overlapping over anterior margin of metaventrite; median part flat; bearing sparsely arranged shallow setiferous punctures; interstices without microsculpture.

**Metathorax.** Metaventrite distinctly longer than preepisternal elevation of mesothorax, median portion markedly differing from lateral portion in punctation and microsculpture; punctation of median portion sparse, consisting of minute punctures, interstices without microsculpture, shiny. Anterolateral ridges bent posteriad along lateral margin of metaventrite, concave laterally, meeting together and projecting posteriad mesally. Anterior margin of metaventrite not crenulate.

**Abdomen.** Ventrite 1 with additional longitudinal ridges laterally. Ventrites 2–5 without longitudinal ridges; posterior margin of all ventrites lacking denticles.

**Male genitalia.** Aedeagus 0.48 mm long, parameres 0.8× longer than phallobase. Parameres continuously narrowing apicad, bearing two short setae apically. Phallobase wide, 2× longer than wide. Median lobe ca. as long as parameres, nearly parallel-sided, with wide apical projection. Membranous lateral projections of median lobe absent. Gonopore absent.

**Etymology.** The new species is dedicated to the Dominican radio station El Bacharengo, a source of the Caribbean music for the first author during his studies in the Czech Republic.

**Distribution.** *Oosternum bacharengo* sp. n. is a Hispaniolan endemic species currently only known from the type locality in the northeastern part of the Dominican Republic (Hato Mayor province) (Fig. 61).

**Habitat.** Based on the label data, the type specimens was collected in litter between tree buttresses in the rain forest.

### *Oosternum cercyonoides* sp. n.

<http://zoobank.org/4B4F624C-6044-4B16-A829-E7F699B70567>

[http://species-id.net/wiki/Oosternum\\_cercyonoides](http://species-id.net/wiki/Oosternum_cercyonoides)

Figs 5–6, 21, 31, 41, 50, 61

**Type-locality.** Jamaica, St. Thomas P. Portland Gap: 18°1'44.76"N, 76°30'22.40"W, 1676 m.

**Type-specimens** (5 spec.). Holotype female. Original label: "JAMAICA: St. Thomas P. Portland Gap, 17.xii.1972/01.i.1973, S & J. Peck, elevation 5500', cloud for., dung & carrion tr. [printed] / Holotype, *Oosternum cercyonoides* sp. n., Deler-Hernández & Fikáček det. 2013 [red, printed]" (CNC). Paratypes: **JAMAICA:** St. Thomas P. Portland Gap: same data as holotype (4 spec., CNC, BSC-E, NMPC).

**Diagnosis.** Body widest ca at midlength. Lateral margin of pronotum angulate. Pronotal punctation uniform in size, moderately dense consisting of small rasp-like punctures. Pronotal interstices without microsculpture. Mesal part of prosternum not divided from lateral portions. Lateral margin of antennal grooves subangulate. Elytral interval 2 of the same width as interval 3, as high as intervals 1 and 3, reaching elytral apex. Elytral intervals 5, 7 and 9 as convex as adjacent intervals. Elytral interstices shiny, without microsculpture. Preepisternal plate wide, drop-like, 1.7× longer than wide. Interstices without microsculpture, shiny. Anterolateral ridges of metaventricle not meeting together of median part of metaventricle mesally.

**Description. Habitus.** Body elongate oval, gradually narrowing posteriad; total length /total width ratio = 2.5. Length: 1.9–1.95 mm, length of holotype: 1.9 mm; width: 0.75–0.78 mm, width of holotype: 0.78 mm.

**Coloration.** Coloration of dorsal side brown to dark brown, elytra darker than pronotum, head dark brown. Ventral side brown. Femora and tibiae brown, tarsi and mouthparts yellow.

**Head.** Clypeus with sparse punctation consisting of small rounded punctures, each puncture bearing fine decumbent

seta; setae pale; interstices without microsculpture; anterior margin of clypeus truncate. Frons with dense punctation consisting of coarse, impressed rounded punctures, punctures of same shape medially and laterally; interstices without microsculpture. Eyes moderately large. Mentum 1.8× wider than long, anterior margin slightly emarginate; anteromedian part not distinctly impressed; with sparse punctation, consisting of small, nearly indistinct punctures bearing minute setae; interstices with very fine microsculpture, opaque. Submentum without poriferous disc-like fields. Maxillary palpus with palpomeres 2 and 4 ca. 1.2× longer than palpomere 3.

**Prothorax.** Pronotum evenly convex forming continuous curve with elytra in lateral view. Lateral margin of pronotum angulate, with narrow marginal bead. Pronotal punctation uniform in size, moderately dense, as dense as that on frons, consisting of small rasp-like punctures similar on whole surface of pronotum; all punctures bearing long setae; interstices without microsculpture. Median portion of prosternum not elevated and demarcated from lateral portions, median carina of prosternum narrow, not projecting more anteriorly than anterior margin of median portion, with anterior portion elevated into small tooth in lateral view. Postero-mesal projection with deep notch. Antennal grooves moderately large. Lateral margin of antennal grooves subangulate.

**Mesothorax.** Scutellar shield bearing a few small rasp-like punctures; interstices without microsculpture. Elytral series 1–5 and 8 arising basally, series 6–7 and 9 joint subbasally. Serial punctures small; transverse; sparsely arranged; with minute setae (indistinct under binocular microscope). Interval 2 of the same width as interval 3, as high as intervals 1 and 3, reaching elytral apex, intervals 5, 7 and 9 as convex as adjacent intervals. Elytral interstices shiny, without microsculpture. Preepisternal plate wide, drop-like, 1.7× longer than wide, widely attached to metaventricle; posterior part of preepisternal elevation slightly overlapping over anterior margin of metaventricle; median part flat; bearing sparsely arranged shallow setiferous punctures; interstices without microsculpture.

**Metathorax.** Metaventricle distinctly shorter than preepisternal elevation of mesothorax, median portion markedly differing from lateral portion in punctation and microsculpture; punctation of median portion consisting of sparsely arranged but large rasp-like setiferous punctures, interstices without microsculpture, shiny. Anterolateral ridges bent posteriad along lateral margin of metaventricle, concave laterally, not meeting together mesally. Anterior margin of metaventricle not crenulate.

**Abdomen.** Ventricle 1 with additional longitudinal ridges laterally. Ventrites 2–5 without longitudinal ridges; posterior margin of all ventrites lacking denticles.

**Etymology.** The species name is derived from the name of the megasternine genus *Cercyon* Leach, 1817, reflecting the *Cercyon*-like appearance of this new species.

**Distribution.** *Oosternum cercyonoides* sp. n. is a Jamaican endemic currently only known from the type lo-



cality in the Blue Mountains, i.e. the highest mountain massif in the eastern part of the island (Fig. 61).

**Habitat.** Based on the label data, the specimens were collected using baited pitfall traps in the montane cloud forest.

***Oosternum insulare* sp. n.**

<http://zoobank.org/725652DA-DD49-4A9C-867F-077D6788AB5F>

[http://species-id.net/wiki/Oosternum\\_insulare](http://species-id.net/wiki/Oosternum_insulare)

Figs 7–8, 22, 35, 42, 55, 61

**Type-locality.** Jamaica: Cockpit Country, 18°20'51.7"N, 77°38'29.7"W, 250 m, trail to upper Windsor Cave.

**Type-specimens** (10 spec.). Holotype male, dry mounted, with genitalia mounted in Euparal on a microslide pinned below the specimen. Original label: "JAMAICA, Cockpit Country, trail to upper Windsor Cave, 11.xi.2013, ca. 250 m a.s.l., 18°20'51.7"N, 77°38'29.7"W, F. Cala-Riquelme leg. [printed] / Holotype, *Oosternum insulare* sp. n., Deler-Hernández & Fikáček det. 2013 [red, printed]" (NMPC). Paratypes: **JAMAICA:** Cockpit Country: same data as holotype (5 spec., NMPC, CMN, SEMC, BMNH). Trelawny, 5 mi. N. Alberttown, 30.xii.1972, S&J. Peck leg. Ber. 250 (3 spec., CNC). Portland: 1 mi W Ecclesdown, 18°5'33.08"N, 76°30'3.64"W, 10.viii.1974, S & J. Peck leg., 1500' (1 spec., CNC).

**Diagnosis.** Body widest ca at midlength. Lateral margin of pronotum angulate. Pronotal punctation uniform in size, dense, consisting of large rounded punctures. Pronotal interstices without microsculpture. Mesal part of prosternum divided from lateral portions by oblique sharp ridges. Lateral margin of antennal grooves with acute projection. Elytral interval 2 narrower than interval 3, lower than intervals 1 and 3, reaching elytral apex. Elytral intervals 5, 7 and 9 distinctly higher than adjacent intervals. Elytral interstices shiny, without microsculpture. Preepisternal plate wide, drop-like, 1.8× longer than wide. Median elevate portion of metaventricle nearly reaching lateral margins, interstices of median part of metaventricle with very fine microsculpture, opaque. Anterolateral ridges of metaventricle not meeting together mesally. Parameres 0.7× longer than phallobase, bearing a single seta apically. Median lobe ca. 1.5× longer than parameres, slight narrowing from base towards apex, with minute apical projection. Membranous lateral projections of median lobe absent.

**Description. Habitus.** Body elongate oval, gradually narrowing posteriad; total length /total width = 1.6. Length: 1.3–1.4 mm, length of holotype: 1.4 mm; width: 0.78–0.84 mm, width of holotype: 0.84 mm.

**Coloration.** Coloration of dorsal side reddish brown. Ventral side dark to reddish brown. Femora and tibiae dark brown, tarsi, mouthparts and antennomeres 1–6 yellowish.

**Head.** Clypeus with sparse punctation consisting of fine puncture, each puncture bearing fine decumbent seta; setae pale; interstices without microsculpture;

anterior margin of clypeus slightly concave. Frons with dense punctation consisting of coarse rounded punctures, punctures of same shape medially and laterally; interstices without microsculpture. Eyes moderately large. Mentum 1.9× wider than long, anterior margin slightly emarginate; anteromedian part deeply impressed in contrast to lateral portions; with sparse punctation, punctation consisting of small, nearly indistinct punctures bearing minute setae; interstices with very fine microsculpture, opaque. Submentum without poriferous disc-like fields. Maxillary palpus with palpomeres 2 and 4 ca. 1.2× longer than palpomere 3. Antenna with 9 antennomeres; scapus shorter than antennomeres 2–6 combined.

**Prothorax.** Pronotum evenly convex, slightly more convex than elytra in lateral view; lateral margin angulate, with narrow marginal bead. Pronotal punctation consisting of two types of punctures, large rounded without seta and smaller transverse with long seta; interstices without microsculpture. Transverse row of punctures on posterior margin of pronotum hardly defined. Median portion of prosternum elevated and demarcated from lateral portion. Median carina of prosternum narrow, projecting more anteriorly mesally than anterior margin of median portion, straight in lateral view. Median portion of prosternum 1.2× wider than long, postero-mesal projection with shallow notch. Pair of deep pits next to ridge delimiting median portion of prosternum present. Antennal grooves moderately large. Lateral margin of antennal grooves with acute projection.

**Mesothorax.** Scutellar shield bearing a few small, round punctures; interstices without microsculpture. Elytral series 1–6 arising basally, series 7–9 subbasally. Serial punctures small; transverse; sparsely arranged, with minute setae (indistinct under binocular microscope). Interval 2 narrower than interval 3, lower than intervals 1 and 3, reaching elytral apex, intervals 5, 7 and 9 distinctly higher than adjacent intervals. Elytral interstices shiny, without microsculpture. Preepisternal plate wide, drop-like, 1.8× longer than wide, widely attached to metaventricle; posterior part of preepisternal elevation slightly overlapping over anterior margin of metaventricle; median part flat, bearing densely arranged, large, shallow setiferous punctures; interstices with very fine microsculpture, opaque.

**Metathorax.** Metaventricle ca. as long as preepisternal elevation of mesothorax, median portion markedly differing from lateral portion in punctation and microsculpture reaching nearly to lateral margin; punctation of median portion sparse consisting of small, rounded punctures, interstices without microsculpture, shiny. Anterolateral ridges bent posteriad along lateral margin of metaventricle, angulate laterally, not meeting together mesally. Anterior margin of metaventricle crenulate.

**Abdomen.** Ventricle 1 with additional longitudinal ridges laterally. Ventrites 2–5 without longitudinal ridges; posterior margin of all ventrites lacking denticles.

**Male genitalia.** Aedeagus 0.57 mm long, parameres 0.7× longer than phallobase. Parameres continuously narrowing apicad, bearing a single seta apically. Phallobase

narrow, 3× longer than wide. Median lobe ca. 1.5× longer than parameres, slight narrowing from base towards apex, with minute apical projection. Membranous lateral projections of median lobe absent. Gonopore absent.

**Etymology.** The species name is the manuscript name used in an unpublished revision of the genus *Oosternum* by M. Hansen – it was the only West Indian endemic in the manuscript, hence the highlighting of the fact that it is the island endemic.

**Distribution.** *Oosternum insulare* sp. n. is the Jamaican endemic currently known from three localities throughout the island, all situated in the altitudes around 500 m a.s.l. (Fig. 61).

**Habitat.** Specimens of *O. insulare* were collected from leaf litter of the well-preserved semi-deciduous forest in the karst area.

### *Oosternum latum* Fikáček, Hebauer & Hansen, 2009

[http://species-id.net/wiki/Oosternum\\_latum](http://species-id.net/wiki/Oosternum_latum)

Figs 9–10, 23, 36, 43, 56, 61

*Oosternum latum* Fikáček, Hebauer & Hansen, 2009: 34.

**New material examined** (21 spec.). **SAINT VINCENT AND GRENADINAS:** Hermitage Forest, E. of Spring Village, ca. 360 m a.s.l., 13°14'53.04"N, 61°12'47.49"W, 16–27.viii.2006, S & J. Peck leg., forest FIT (06-105) (10 spec., SBPC, NMPC), 15–27.viii.2006, S & J. Peck leg., clearing FIT trap, (06-101B) (1 spec., SBPC), 16–27.viii.2006, S & J. Peck leg., forest edge Malaise, (06-104) (10 spec., SBPC, NMPC).

**Diagnosis.** Body widest on base of elytra. Lateral margin of pronotum angulate. Pronotal punctation uniform in size, sparse, consisting of small, rasp-like, weakly impressed punctures. Pronotal interstices with microsculpture. Mesal part of prosternum divided from lateral portions by oblique sharp ridges. Lateral margin of antennal grooves with acute projection. Elytral interval 2 narrower than interval 3, lower than intervals 1 and 3, reaching elytral apex. Intervals 5, 7 and 9 distinctly higher than adjacent intervals. Elytral interstices opaque, with very fine microsculpture. Preepisternal plate wide, suboval, 2× longer than wide. Interstices of median part of metaventrite without microsculpture, with subpentagonal slightly elevate median portion. Anterolateral ridges of metaventrite not meeting together mesally. Parameres 1.2× longer than phallobase, bearing two short setae apically. Median lobe longer than parameres, projecting slightly farther than parameres, nearly parallel-sided basally, narrowing apicad in apical 0.2. Membranous lateral projections of median lobe present.

**Description.** For complete description see Fikáček et al. (2009).

**Distribution.** *Oosternum latum* is the endemic of the Saint Vincent Island (Fig. 61). The specimens examined for this study represent the first precisely localized material available for the species, as only the island name

is mentioned in the locality label of the type specimens (Fikáček et al. 2009).

**Habitat.** Specimens of *O. latum* examined here were collected in a lower montane rain forest with mixed forest plant compositions. A portion of the specimens were collected using flight intercept traps, and others using a Malaise trap.

### *Oosternum luciae* sp. n.

<http://zoobank.org/DEF8AEF2-93DB-449D-BFB6-7D0157A566BB>

[http://species-id.net/wiki/Oosternum\\_luciae](http://species-id.net/wiki/Oosternum_luciae)

Figs 11–12, 24, 37, 44, 57, 61

**Type-locality.** Saint Lucia, Barre de L'Isle: 13.9368°N, 60.9593°W, 340 m.

**Type-specimens** (1 spec.). Holotype male, dry mounted, with genitalia mounted in Euparal on a microslide pinned below the specimen. Original label: “ST LUCIA: Barre de L'Isle, 25/28.v.2009, E. A. Ivie, 13.9368°N, 60.9593°W, elevation 340 m, [printed] / Holotype, *Oosternum luciae* sp. n., Deler-Hernández & Fikáček det. 2013 [red, printed]” (WIFP).

**Diagnosis.** Body widest ca at midlength. Lateral margin of pronotum weakly sinuate. Pronotal punctation uniform in size, moderately dense consisting of small, transverse punctures. Pronotal interstices with microsculpture. Mesal part of prosternum divided from lateral portions by oblique sharp ridges. Lateral margin of antennal grooves with acute projection. Elytral interval 2 narrower than interval 3, lower than intervals 1 and 3, reaching elytral apex. Elytral intervals 5, 7 and 9 distinctly higher than adjacent intervals. Elytral interstices shiny, without microsculpture. Preepisternal plate narrow, drop-like, 2.6× longer than wide. Interstices of median portion of metaventrite with strong mesh-like microsculpture on the whole surface. Anterolateral ridges of metaventrite not meeting together mesally. Parameres 1.2× longer than phallobase, bearing two short setae apically. Median lobe slightly longer than parameres, nearly parallel-sided basally, narrowing apicad in apical 0.4. Membranous lateral projections of median lobe present, with series of long setae on each side.

**Description. Habitus.** Body widely oval, strongly narrowing posteriad; total length / total width ratio = 1.3. Length: 1.41 mm; width: 0.87 mm.

**Coloration.** Coloration of dorsal side of head, pronotum and elytra dark brown. Ventral side brown.

**Head.** Clypeus with sparse punctation consisting of fine, each puncture bearing fine decumbent seta; setae pale; interstices with fine microsculpture; anterior margin of clypeus slightly concave. Frons with moderately dense punctation consisting of small, shallowly impressed rounded to slightly transverse punctures, punctures of same shape medially and laterally; interstices with fine mesh-like microsculpture. Eyes moderately large. Mentum 1.9× wider than long, anterior margin slightly emarginate; anteromedian part deeply impressed in contrast to lateral portions; with sparse punctation, punctation consisting of small, nearly indistinct punctures

bearing minute setae; interstices with fine microsculpture consisting of transverse ridges. Submentum without poriferous disc-like fields. Maxillary palpus with palpomeres 2 and 4 ca.  $1.2\times$  longer than palpomere 3. Antenna with 9 antennomeres; scapus shorter than antennomeres 2–6 combined. Evenly convex.

**Prothorax.** Pronotum forming continuous curve with elytra in lateral view; lateral margin weakly sinuate, with narrow marginal bead. Pronotal punctation uniform in size, moderately dense, as dense as that on frons consisting of small, transverse punctures similar on whole surface of pronotum; punctures with minute setae intermixed among those bearing long setae; interstices with microsculpture. Transverse row of punctures on posterior margin of pronotum absent. Median portion of prosternum elevated and demarcated from lateral portins; median carina of prosternum narrow, projecting more anteriad mesally than anterior margin of median portion, with anterior portion elevated into small tooth in lateral view. Median portion of prosternum  $1.8\times$  wider than long, postero-mesal projection with shallow notch. Pair of deep pits next to ridge delimiting median portion of prosternum present. Antennal grooves moderately large. Lateral margin of antennal grooves with acute projection.

**Mesothorax.** Scutellar shield bearing few minute rounded punctures; interstices without microsculpture. Elytral punctures coarse, shallowly impressed rounded to slightly transverse. Serial punctures small; transverse; sparsely arranged, with minute setae (indistinct under binocular microscope). Elytral interval 2 narrower than interval 3, lower than intervals 1 and 3, reaching elytral apex. Elytral intervals 5, 7 and 9 distinctly higher than adjacent intervals. Elytral interstices shiny, without microsculpture. Preepisternal plate narrow, drop-like,  $2.6\times$  longer than wide, widely attached to metaventrte; posterior part of preepisternal elevation slightly overlapping over anterior margin of metaventrte, median part flat, bearing densely arranged, large, shallow setiferous punctures; interstices with very fine microsculpture, opaque.

**Metathorax.** Metaventrte ca. as long as preepisternal elevation of mesothorax, median portion markedly differing from lateral portion in punctation and microsculpture; punctation of median portion moderately dense, consisting of large, sharply impressed round setiferous punctures, interstices with strong mesh-like microsculpture on the whole surface. Anterolateral ridges bent posteriad along lateral margin of metaventrte, concave, laterally not meeting together mesally. Anterior margin of metaventrte not crenulate.

**Abdomen.** Ventrte 1 with additional longitudinal ridges laterally. Ventrites 2–5 without longitudinal ridges; posterior margin of all ventrites lacking denticles.

**Male genitalia.** Aedeagus 0.44 mm long, parameres  $1.2\times$  longer than phallobase. Parameres continuously narrowing apicad, bearing two short setae apically. Phallobase narrow,  $1.9\times$  longer than wide. Median lobe slightly longer than parameres, nearly parallel-sided basally, nar-

rowing apicad in apical 0.4. Membranous lateral projections of median lobe present. Gonopore present.

**Etymology.** The species name is derived from the woman's name Lucia, referring to the presence of this species in the Saint Lucia island.

**Distribution.** *Oosternum luciae* sp. n. is an endemic of Saint Lucia island and currently known only from the type locality (Fig. 61).

**Habitat.** Based on the label data, the type specimen was collected using an UV light trap.

### *Oosternum megnai* sp. n.

<http://zoobank.org/E11CD275-C61D-42D2-BBDD-D8258ED20B73>

[http://species-id.net/wiki/Oosternum\\_megnai](http://species-id.net/wiki/Oosternum_megnai)

Figs 13–14, 25, 32, 45, 51, 58, 61

**Type-locality.** Cuba, Granma Province: PN Turquino,  $20^{\circ}0.9'N$ ,  $76^{\circ}53.3'W$ , slope below Pico Naranjo ca. 0.4 km N of La Platica (by air), 950 m.

**Type-specimens** (13 spec.). Holotype male, dry mounted, with genitalia mounted in Euparal on a microslide attach to the specimens. Original label: "CUBA: Granma: PN Turquino, slope below Pico Naranjo ca. 04 km N of La Platica (by air), 24.vi.2012, Deler-Hernández & Fikáček leg.  $20^{\circ}0.9'N$ ,  $76^{\circ}53.3'W$ , elevation 950 m, MF23 [printed] / Holotype, *Oosternum megnai* sp. n., Deler-Hernández & Fikáček det. 2013 [red, printed]" (NMPC). Paratypes **CUBA:** Granma province: same data as holotype (12 spec., NMPC, CMN, SEMC, BSC-E, BMNH).

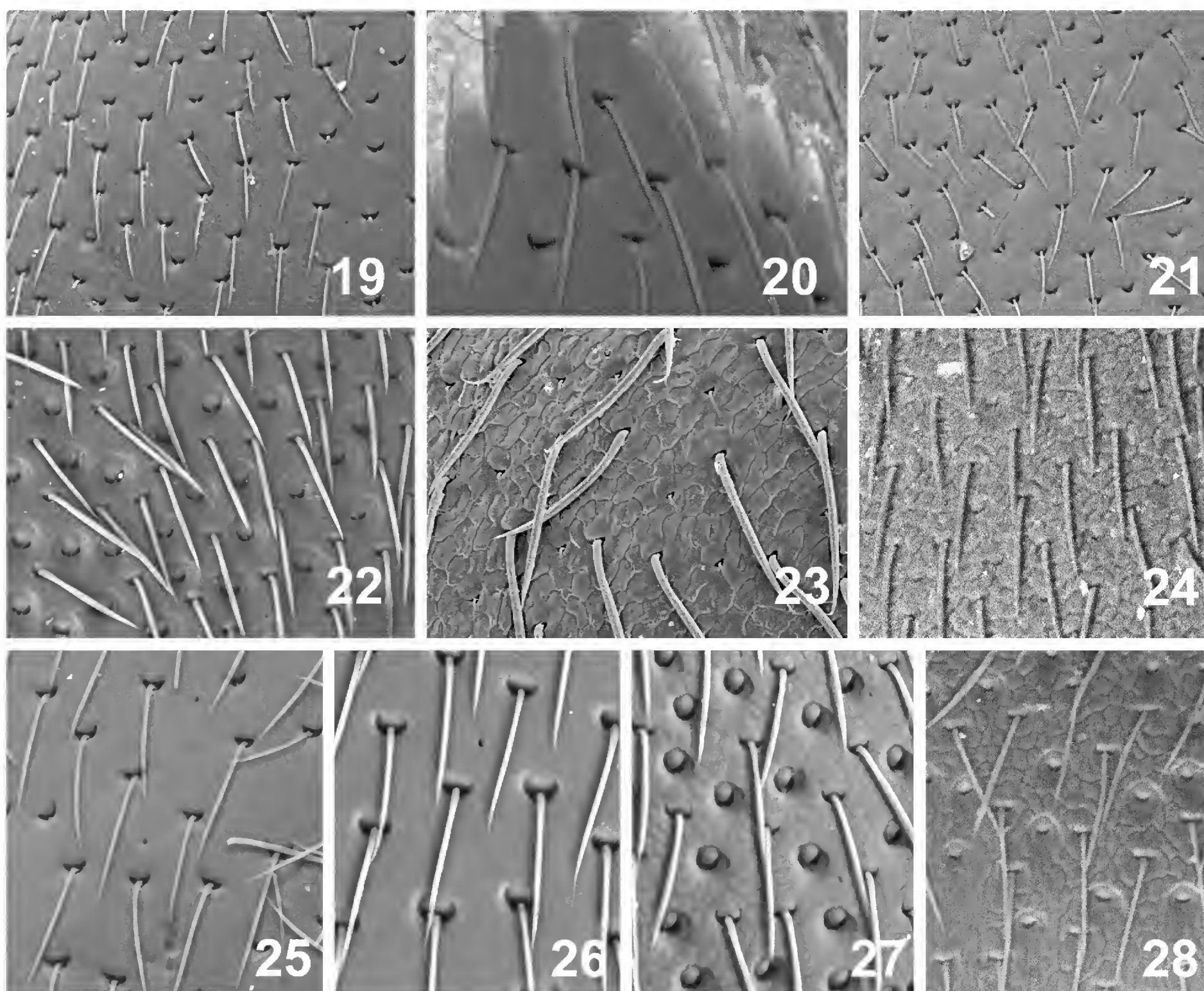
**Diagnosis.** Body widest ca at midlength. Lateral margin of pronotum angulate. Punctation uniform in size, moderately dense, consisting of small, rasp-like punctures. Pronotal interstices without microsculpture. Mesal part of prosternum not divided from lateral portions. Lateral margin of antennal grooves rounded. Elytral interval 2 narrower than interval 3, as high as intervals 1 and 3, reaching elytral apex. Elytral intervals 5, 7 and 9 as convex as adjacent intervals. Elytral interstices shiny, without microsculpture. Preepisternal plate narrow, drop-like,  $2.3\times$  longer than wide. Interstices of median part of metaventrte without microsculpture. Anterolateral ridges of metaventrte not meeting together mesally. Parameres  $0.8\times$  longer than phallobase, bearing two long setae apically. Median lobe longer than parameres, oval in shape, with small apical projection. Membranous lateral projections of median lobe absent.

**Description. Habitus.** Body elongate oval, gradually narrowing posteriad; total length/total width ratio = 1.9. Length: 1.47–1.49 mm, length of holotype: 1.32 mm; width: 0.75–0.82 mm, width of holotype: 0.8 mm.

**Coloration.** Coloration of dorsal side brown to dark brown, head, pronotum and elytra dark brown. Ventral side light brown. Femora, tibiae, tarsi and antennomeres and light brown, antennal club dark brown.

**Head.** Clypeus with moderately dense punctation consisting of fine punctures, each puncture bearing





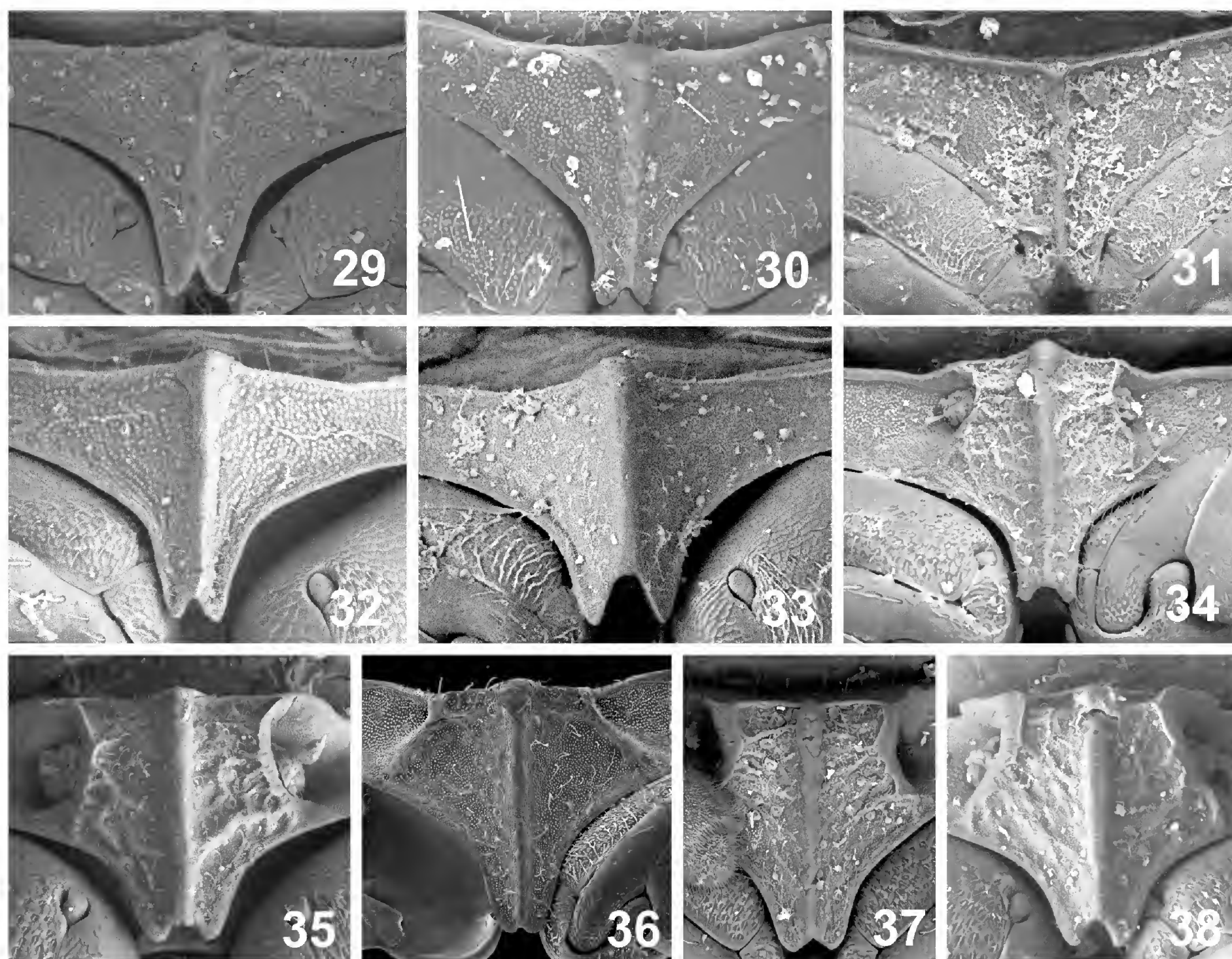
**Figures 19–28.** Pronotal punctation and microsculpture. 19. *Oosternum andersoni* 20. *O. bacharenge* 21. *O. cercyonoides* 22. *O. insulare* 23. *O. latum* 24. *O. luciae* 25. *O. megnai* 26. *O. pecki* 27. *O. sharpi* 28. *Oosternum* sp. (Bahamas).

fine decumbent seta; setae pale; interstices without microsculpture; anterior margin of clypeus truncate. Frons with dense punctation consisting of small, punctures of same shape medially and laterally; interstices without microsculpture. Eyes moderately large. Mentum  $1.8\times$  wider than long, anterior margin deeply emarginate; anteromedian part not distinctly impressed; with sparse punctation, punctation consisting of minute, nearly indistinct punctures bearing minute setae; interstices with fine microsculpture consisting of transverse ridges. Submentum without poriferous disc-like fields. Maxillary palpus with palpomeres 2 and 4 ca.  $1.2\times$  longer than palpomere 3. Antenna with 9 antennomeres; scapus shorter than antennomeres 2–6 combined.

**Prothorax.** Pronotum evenly convex forming continuous curve with elytra in lateral view. Lateral margin of pronotum angulate; with narrow marginal bead. Pronotal punctation uniform in size, moderately dense, as dense as that on frons; consisting of small rasp-like punctures, slightly sparser laterally than medially; all punctures bearing long setae; interstices without

microsculpture. Median portion of prosternum not elevated and demarcated from lateral portions, median carina of prosternum narrow, projecting more anteriorly than anterior margin of median portion, with anterior portion elevated into small tooth in lateral view. Postero-mesal projection with shallow notch. Antennal grooves moderately large. Lateral margin of antennal grooves rounded.

**Mesothorax.** Scutellar shield bearing a few small, rasp-like punctures; interstices without microsculpture. Elytral series 1–5 and 8 arising basally, series 6–7 and 9 joint subbasally. Serial punctures small; transverse; sparsely arranged, with minute setae (indistinct under binocular microscope). Elytral interval 2 narrower than interval 3, as high as intervals 1 and 3, reaching elytral apex, intervals 5, 7 and 9 as convex as adjacent intervals. Elytral interstices shiny, without microsculpture. Preepisternal plate narrow, drop-like,  $2.3\times$  longer than wide, widely attached to metaventricle; posterior part of preepisternal elevation slightly overlapping over anterior margin of metaventricle; median part flat; bearing densely



**Figures 29–38.** Median portion of prosternum. 29. *Oosternum andersoni* 30. *O. bacharengae* 31. *O. cercyonoides* 32. *O. megnai* 33. *O. pecki* 34. *Oosternum* sp. (Bahamas) 35. *O. insulare* 36. *O. latum* 37. *O. luciae* 38. *O. sharpi*.

arranged, large, shallow setiferous punctures; interstices without microsculpture.

**Metathorax.** Metaventrite distinctly longer than preepisternal elevation of mesothorax, median portion markedly differing from lateral portion in punctation and microsculpture; punctation of median portion sparse consisting of small rounded punctures, interstices without microsculpture, shiny. Anterolateral ridges bent posteriad along lateral margin of metaventrite, concave laterally, not meeting together mesally. Anterior margin of metaventrite not crenulate.

**Abdomen.** Ventrite 1 with additional longitudinal ridges laterally. Ventrites 2–5 without longitudinal ridges; posterior margin of all ventrites lacking denticles.

**Male genitalia.** Aedeagus 0.52 mm long, parameres 0.8× longer than phallobase. Parameres continuously narrowing apicad, bearing two long setae apically. Phallobase narrow, 2.1× longer than wide. Median lobe longer than parameres, oval in shape, with small apical projection. Membranous lateral projections of median lobe absent. Gonopore absent.

**Etymology.** The new species is dedicated to our excellent colleague and friend Yoandri S. Megna (Universidad de Oriente, Santiago de Cuba, Cuba).

**Distribution.** *Oosternum megnai* sp. n. is the Cuban endemic species currently known only from the type locality in the southeastern part of the island (Granma province) (Fig. 61). The locality is situated in the Sierra Maestra mountain range which is considered one of the main centers of diversity in Cuba (CENAP 2004).

**Habitat.** Specimens of *O. megnai* were collected in dry leaf litter in the secondary forest.

#### *Oosternum pecki* sp. n.

<http://zoobank.org/425E2398-6C4F-4966-A966-E7B1DD0C8207>

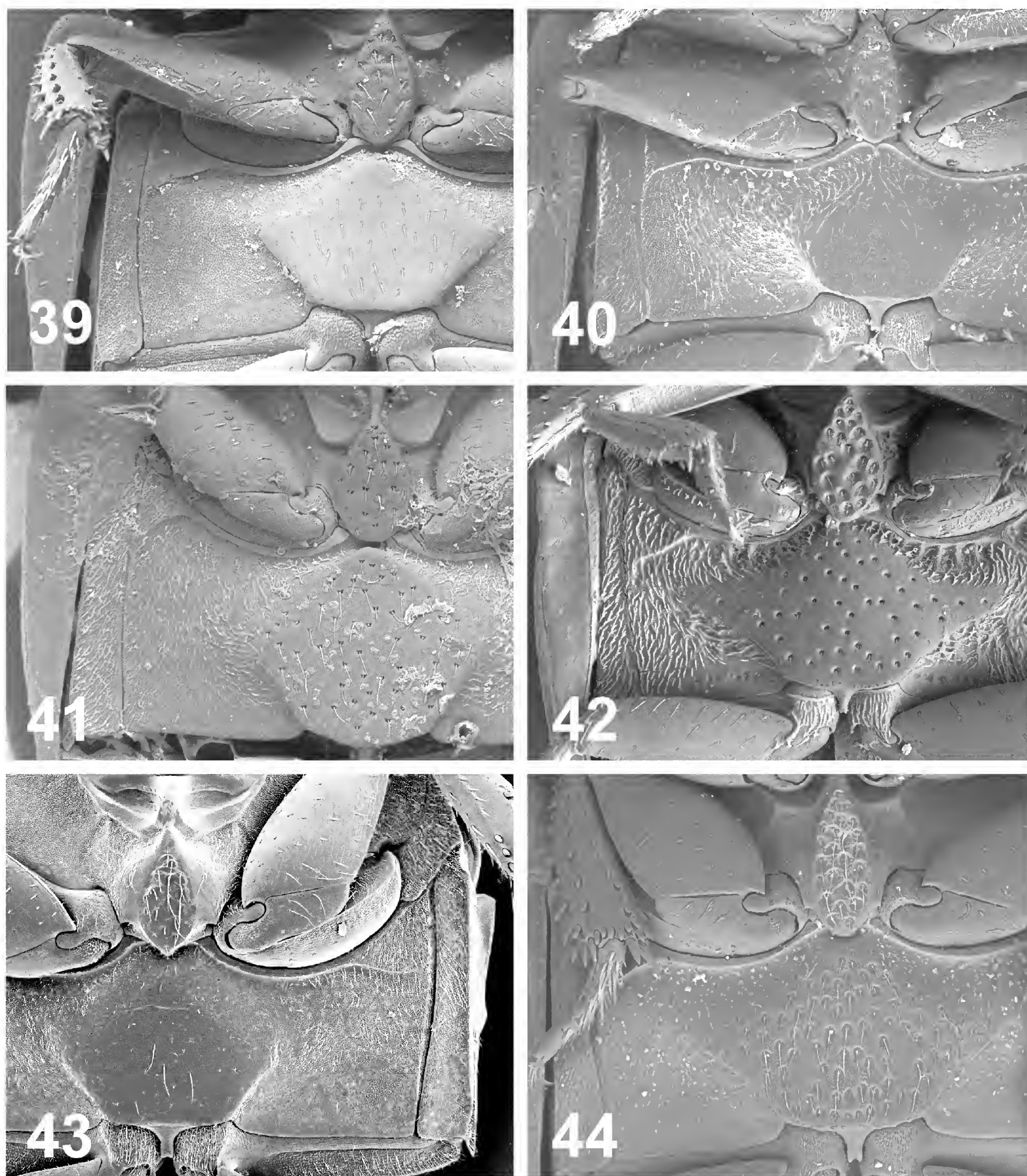
[http://species-id.net/wiki/Oosternum\\_pecki](http://species-id.net/wiki/Oosternum_pecki)

Figs 15–16, 26, 33, 46, 49, 52, 59, 61

**Type-locality.** Dominican Republic, Barahona: 17°59'06.85"N, 71°12'57.29"W, 7 Km NW Paraiso, 200 m.

**Type-specimens** (19 spec.). Holotype male, dry mounted, with genitalia mounted in Euparal on a microslide pinned below the specimen. Original label: "DOM REP: Barahona: 7 Km NW Paraiso, 27.xi/04.xii.1991, Masner & Peck, elevation 200 m, rainforest remnant, intercept tp. [printed] / Holotype, *Oosternum pecki* sp. n., Deler-Hernández & Fikáček det. 2013 [red, printed]" (CNC). Paratypes: DO-



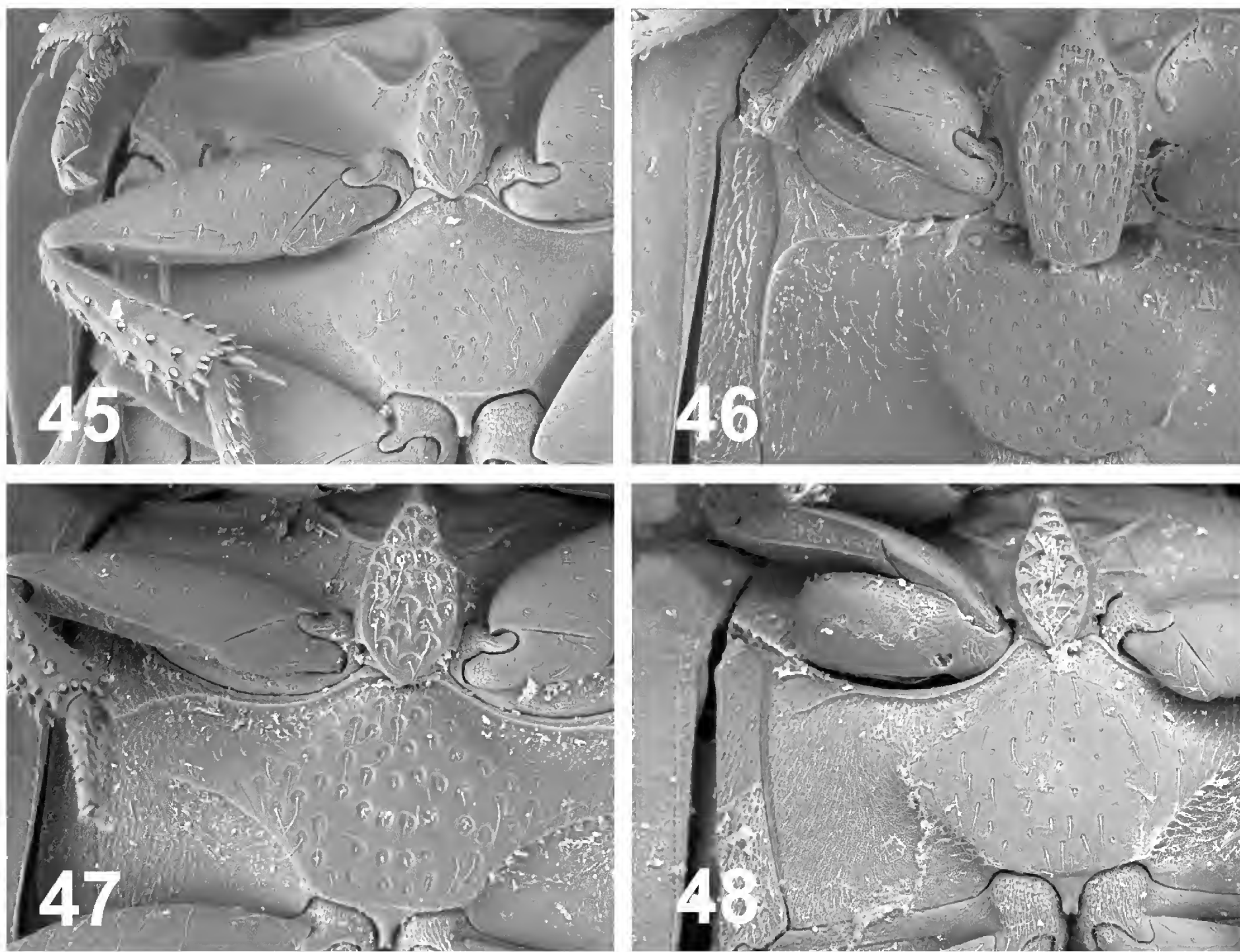


Figures 39–44. Meso- and metaventrite plate. 39. *Oosternum andersoni* 40. *O. bacharenge* 41. *O. cercyonoides* 42. *O. insulare* 43. *O. latum* 44. *O. luciae*.

**MINICAN REPUBLIC:** Barahona: same data as holotype (18 spec., CNC, NMPC, BSC-E, CMN, SEMC).

**Diagnosis.** Body widest ca at midlength. Lateral margin of pronotum angulate. Pronotal punctation double-sized, dense consisting of moderately large round and rasp-like punctures. Pronotal interstices without microsculpture. Mesal part of prosternum not divided from lateral portions. Lateral margin of antennal grooves rounded. Elytral interval 2 narrower than interval 3, lower than intervals 1 and 3,

reaching elytral apex. Elytral intervals 5, 7 and 9 distinctly higher than adjacent intervals. Elytral interstices shiny, without microsculpture. Preepisternal plate wide, sub-rhomboid,  $2.1\times$  longer than wide, largely overlapping over metaventrite. Interstices of median part of metaventrite without microsculpture. Anterolateral ridges of metaventrite not meeting together mesally. Parameres  $1.1\times$  longer than phallobase, bearing two long setae apically. Median lobe ca. as long as parameres, nearly parallel-sided basally,



Figures 45–48. Meso- and metaventrite plate. 45. *O. megnai* 46. *O. pecki* 47. *O. sharpi* 48. *Oosternum* sp.

narrowing apicad in apical 0.2, apex rounded. Membranous lateral projections of median lobe absent.

**Description. Habitus.** Body elongate oval, gradually narrowing posteriad; total length/total width ratio = 1.6. Length: 1.45–1.5 mm, length of holotype: 1.41 mm; width: 0.89–0.97 mm, width of holotype: 0.89 mm.

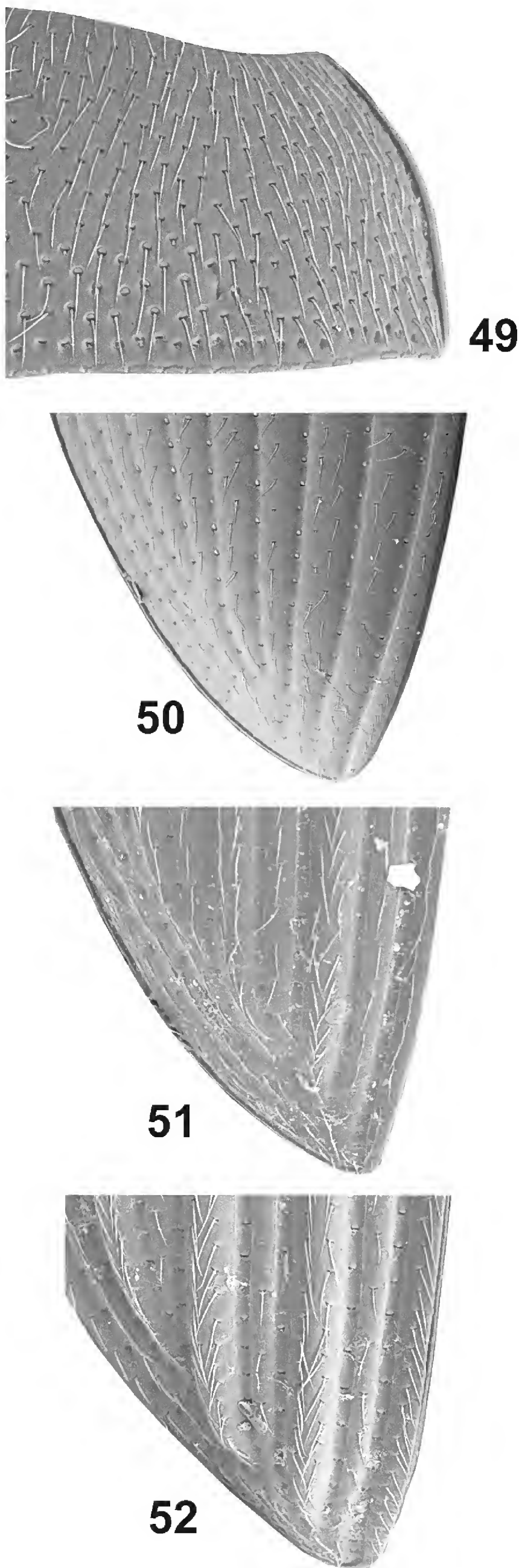
**Coloration.** Coloration of dorsal side reddish brown. Ventral side brown to reddish brown. Femora, tibiae and antennal club pale reddish brown, tarsi and antennomeres 1–6 yellowish.

**Head.** Clypeus with sparse punctation consisting of fine punctures, each puncture bearing fine decumbent seta; setae pale; interstices without microsculpture; anterior margin of clypeus truncate. Frons with dense punctation consisting of small punctures of same shape medially and laterally; interstices without microsculpture. Eyes moderately large. Mentum 1.9× wider than long, anterior margin slightly emarginate; anteromedian part not distinctly impressed; with sparse punctation, punctation consisting of minute, nearly indistinct punctures bearing minute setae; interstices with fine microsculpture consisting of transverse ridges. Submentum without poriferous disc-like fields. Maxillary palpus with palpomeres 2 and 4 ca. 1.2× longer than palpomere 3. Antenna with 9 antennomeres; scapus shorter than antennomeres 2–6 combined.

**Prothorax.** Pronotum evenly convex, forming continuous curve with elytra in lateral view. Lateral margin of pronotum angulate, with narrow marginal bead. Pronotal punctation double-sized, dense, slightly denser than on frons, consisting of transverse punctures anteriorly and large round punctures posteriorly; all punctures bearing long setae; interstices without microsculpture. Median portion of prosternum not elevated and demarcated from lateral portions, median carina of prosternum narrow projecting more anteriorly than anterior margin of median portion, with anterior portion elevated into small tooth in lateral view. Postero-mesal projection with deep notch. Antennal grooves moderately large. Lateral margin of antennal grooves rounded.

**Mesothorax.** Scutellar shield bearing a few small rasp-like punctures; interstices without microsculpture. Elytral series 1–5 and 8 arising basally, series 6–7 and 9 joint subbasally. Serial punctures small; transverse; sparsely arranged, with minute setae (indistinct under binocular microscope). Elytral interval 2 narrower than interval 3, lower than intervals 1 and 3, reaching elytral apex, intervals 5, 7 and 9 distinctly higher than adjacent intervals. Elytral interstices shiny, without microsculpture. Preepisternal plate wide, subrhomboid, 2.1× longer than





**Figures 49–52.** Additional diagnostic characters of West Indian *Oosternum*. (49) Pronotal punctation of *O. pecki*. (50–52) Apical portion of elytra 50. *O. cercyonoides* 51. *O. megnai* 49, 52. *O. pecki*.

wide, widely attached to metaventrite; posterior part of preepisternal elevation much overlapping over anterior margin of metaventrite; median part flat; bearing densely arranged, large, shallow setiferous punctures; interstices without microsculpture.

**Metathorax.** Metaventrite distinctly shorter than preepisternal elevation of mesothorax, median portion markedly differing from lateral portion in punctation and microsculpture; punctation of median portion sparse, consisting of small rounded punctures, interstices without microsculpture, shiny. Anterolateral ridges bent posteriad along lateral margin of metaventrite, concave laterally, not meeting together mesally. Anterior margin of metaventrite not crenulate. Lateral margin with additional slightly concave ridge.

**Abdomen.** Ventrite 1 without additional longitudinal ridges laterally. Ventrites 2–5 without longitudinal ridges; posterior margin of all ventrites lacking denticles.

**Male genitalia.** Aedeagus 0.57 mm long, parameres  $1.1\times$  longer than phallobase. Parameres continuously narrowing apicad, bearing two long setae apically. Phallobase wide,  $1.6\times$  longer than wide. Median lobe ca. as long as parameres, nearly parallel-sided basally, narrowing apicad in apical 0.2, apex rounded. Membranous lateral projections of median lobe absent. Gonopore present.

**Etymology.** The new species is dedicated to Professor Stuart Peck (Carleton University, Canada) whose collecting trips accumulated a huge material of the West Indian Hydrophilidae, including many *Oosternum* specimens used for this study.

**Distribution.** *Oosternum pecki* sp. n. is a Hispaniolan endemic species currently known only from the type locality situated in the southern part of the Dominican Republic (Barahona province) (Fig. 61).

**Habitat.** Based on the label data, the type specimens were collected in a remnant of the rain forest using a flight intercept trap.

### *Oosternum sharpi* Hansen, 1999

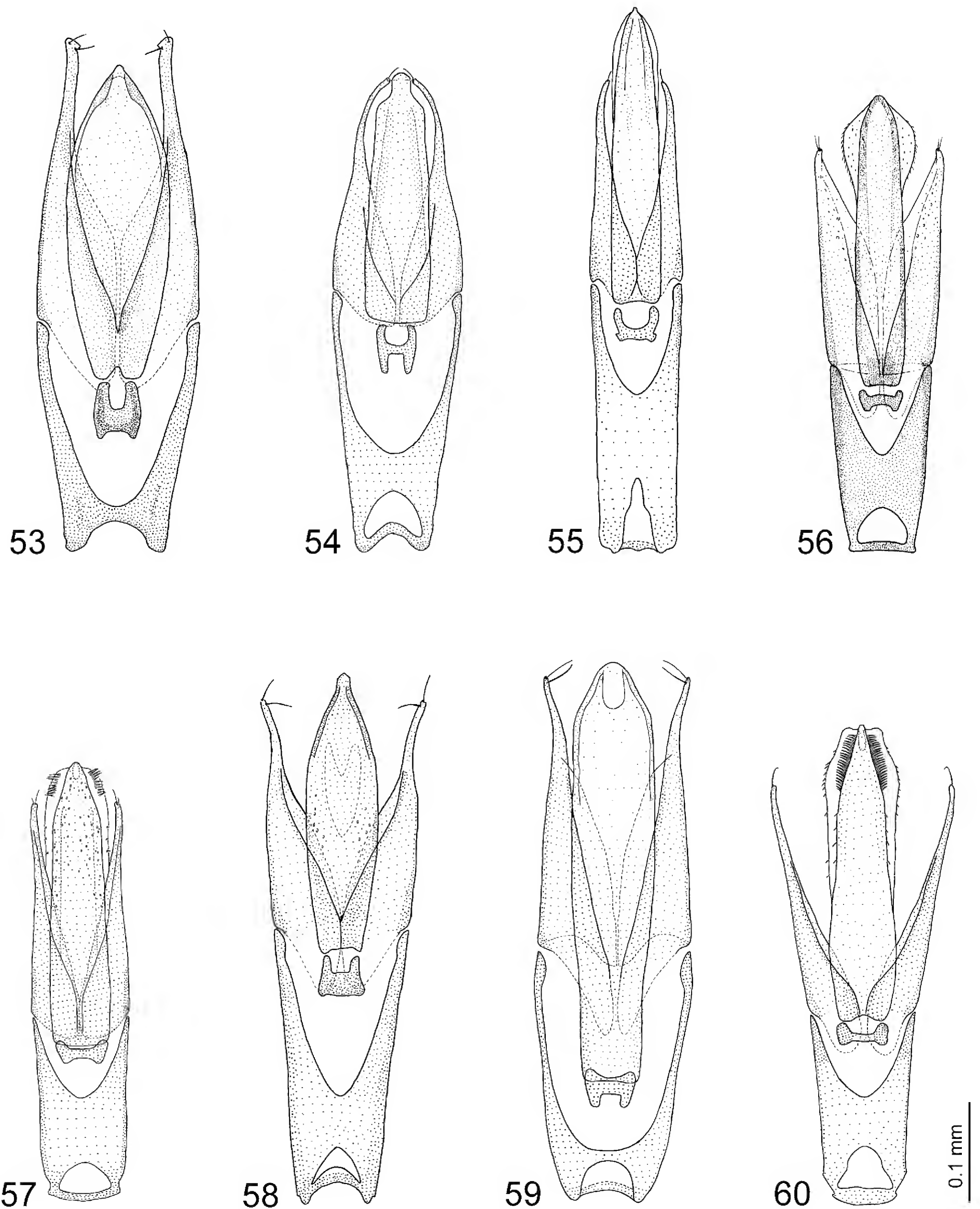
[http://species-id.net/wiki/Oosternum\\_sharpi](http://species-id.net/wiki/Oosternum_sharpi)

Figs 17–18, 27, 38, 47, 60, 61

*Oosternum costatum* Sharp, 1882: 113 (secondary homonym of *Megasternum costatum* LeConte, 1855).

*Oosternum sharpi* Hansen, 1999: 242 (replacement name).

**Material examined** (65 spec.). **CUBA:** Cienfuegos province: Cumanayagua municipality, Jardín Botánico de Cienfuegos, Soledad, ca. 73 m,  $22^{\circ}7'18.44''\text{N}$ ,  $80^{\circ}19'35.26''\text{W}$ , 21.v.2013, A. Deler-Hernández leg., horse excrements (3 spec., NMPC); 01.v.1950, Acc. No 49672 (4 spec., WIFP); Mina Carlota, ca. 470 m,  $22.0667^{\circ}\text{N}$ ,  $80.1667^{\circ}\text{W}$ , 06.v.1950, Acc. No 49681 (1 spec., WIFP). Camagüey province: Sierra de Cubitas municipality, Hoyo de Bonet, Res. Ecol. “Limones-Tuabaquey”, ca. 90 m a.s.l.,  $21^{\circ}36'32.51''\text{N}$ ,  $77^{\circ}47'5.30''\text{W}$ , 14.iv.2012, F. Cala-Riquelme & N. Duperré leg., (CU-20) (1 spec., NMPC). Granma



**Figures 53–60.** Aedeagus. **53.** *Oosternum andersoni* **54.** *O. bacharenge* **55.** *O. insulare* **56.** *O. latum* **57.** *O. luciae* **58.** *O. megnai* **59.** *O. pecki* **60.** *O. sharpi*.

province: PN Turquino track to Pico Turquino, ca. 900 m a.s.l., 20°0.5'N, 76°53.6'W, 29.iii.2012, F. Cala-Riquelme & N. Duperré leg., (CU03) (15 spec., NMPC). Santiago de Cuba province: San Luis municipality, El Vivero 1.6 Km E of Dos Caminos, ca. 150 m a.s.l., 20°10.8'N, 76°46.4'W,

20–21.vi.2012, A. Deler-Hernández & M. Fikáček leg., (MF18) (3 spec., NMPC); Km 7 road to Gran Piedra, ca. 550 m a.s.l., 20.011°N, 75.673°W, 26.i.2012, R. Anderson leg., (2012–007) (1 spec., NMPC). Guantánamo province: El Yunque, 0.5–1.0 Km W of campismo popular, ca.



40–50 m a.s.l., 20°20.1'N 74°33.6'W, 10.vi.2012, A. Deler-Hernández & M. Fikáček leg., (MF01) (1 spec., NMPC). **HAITI:** Port-au-Prince: 18°31'1.33"N, 72°20'7.42"W, 22.v.1950, Acc # 49650, H. B. Mills colr. (4 spec., WIFP). **DOMINICAN REPUBLIC:** Barahona: 7 Km NW Paraiso, ca. 200 m a.s.l., 17°59'06.85"N, 71°12'57.29"W, 27.xi/04.xii.1991, Masner & Peck leg., (91–341) (2 spec., SBPC); 1–04.xii.2012, Masner & Peck leg (91–358) (1 spec., SBPC). **JAMAICA:** Try Good Hope: ca. 145 m a.s.l., 18°25'N, 77°41'W, 17.viii.1966, H. F. Howden leg., (1 spec., SBPC); Trelawny Par. Nr. Windsor Caves, 18°20'59.21"N, 77°38'56.11"W, 24.iii.1991, T. K. Phillip and L. Gerofsky leg., berlese stream-side leaves (1 spec., WIFP). **PUERTO RICO:** 3.5 Km S Cabo Rojo, Cueva Tuna, ca. 25 m, 18°02'N, 67°09'W, 14.vi.1974, S. Peck leg., (1 spec., SBPC); Aguas Buenas, near Aguas Buenas Cave, ca. 250 m a.s.l., 18°15'N, 66°07'W, 07–17.v.1973, S. Peck leg., (1 male, SBPC); 2 km S Mamayas (Palmer), ca. 70 m, 18°21'13.63"N, 65°46'36.05"W, 25.IX.1987, M. Ivie, ex. old lawn debris (3 spec., WIFP); Isla Verde, vii/viii.1957, I. Fox lgt, light trap (1 spec., WIFP); El Verde, ca 250 m, 18°19'27.35"N, 65°49'26.90"W, M. A. Ivie lgt, at light (1 spec., WIFP). **BARBADOS:** Colescave: 1 Km SSE Welchman Hall, ca. 200 m a.s.l., 13°11'N, 59°34'W, 22–26.ii.1979, S. Peck leg., (3 spec., SBPC); Welchman Hall Gully, ca. 270 m a.s.l., 13°11.74'N, 59°34.60'W, 26.v.2006, S & P. Peck leg (06–60) (1 spec., SBPC). **TRINIDAD & TOBAGO:** Curupe: ca. 13 m a.s.l., 10°38'21.96"N, 61°24'35.91"W 05.xii.1977, W.R.M. Mason leg (1 spec., SBPC). **SAINT LUCIA:** Vieux Fort, ca. 3 m a.s.l., 13°43'18.68"N, 60°56'58.86"W, 12.vii.2007, S & P. Peck leg (07–60) (1 spec., SBPC). **SABA:** Neth Antil, ca. 384 m a.s.l., 17°37'43.45"N, 63°13'47.93"W, 20.V.2008, D. S. Sikes & M. A. Ivie leg, berlese litter/lawn clipping, (1 spec., WIFP). **DOMINICA:** Springfield Estate, ca. 330–360 m a.s.l., 15°20.796'N, 61°22.142'W, 30.v/16.vi.2004, S & P. Peck leg (04–86) (1 spec., SBPC). **SAINT VINCENT AND GRENADINAS:** Esmerald Valley Hotel, E. of Layou, ca. 20 m a.s.l., 13°12'N, 61°14.8'W, 27–29.viii.2006, S & J. Peck leg., forest edge UV, (06–123) (6 spec., SBPC); Buccament. Esmerald Valley Hotel, ca. 20 m a.s.l., 13°12'36.18"N, 61°13'47.74"W, 10–20.vi.2007, S & P. Peck leg (07–12) (1 spec., SBPC), Bequia island, Hamilton, ca. 25 m a.s.l., 13°00'30"N, 61°14'W, 01.viii.2008, S. Peck & M. de Silva leg (08–75) (1 spec., SBPC). **GUADELOUPE:** BT Malendure, Petite Trace, Fond Ravine, ca. 3 m a.s.l., 16°10.44'N, 61°46.7'W, 21.v.2012, S. Peck leg., forest edge UV, (12–31) (2 spec., SBPC). **VIRGIN ISLAND:** St. John, Dennis Bay, ca. 5 m, 18°21'7.08"N, 64°46'29.86"W, 16.vi.1980, (1 spec., WIFP); Maho Bay, ca 30 m, 18°21'41.92"N, 64°44'32.81"W, 12.iii.1984, W. B. colr, under trees near road, (1 spec., WIFP); St. Thomas, ca. 50 m, 18°21'20.93"N, 64°55'31.20"W, 05.viii.1984, (1 spec., WIFP).

**Diagnosis.** Body widest ca at midlength. Lateral margin of pronotum angulate. Pronotal punctation double-sized, dense consisting of moderately large, round punctures intermixed with smaller transverse punctures. Pronotal

interstices with microsculpture. Mesal part of prosternum divided from lateral portions by oblique sharp ridges. Lateral margin of antennal grooves with acute projection. Elytral interval 2 narrower than interval 3, lower than intervals 1 and 3, reaching elytral apex. Elytral intervals 5, 7 and 9 distinctly higher than adjacent intervals. Elytral interstices shiny, without microsculpture. Preepisternal plate wide, drop-like, 2× longer than wide. Interstices of median part of metaventrite with very fine microsculpture, opaque. Anterolateral ridges not meeting together mesally. Parameres 1.2× longer than phallobase, bearing a single seta apically. Median lobe longer than parameres, narrowing towards apex. Membranous lateral projections of median lobe large, bearing long setae on each side.

**Distribution.** *Oosternum sharpi* is a common species distributed throughout the West Indies. We are recording it from all islands of the Greater Antilles (Cuba, Jamaica, Hispaniola and Puerto Rico) as well as from 9 islands of the Lesser Antilles. The species is otherwise widely distributed in southern USA, Central America and northern part of the South America, and was also introduced to the Azores (Orchymont 1940, Svensson 1973), Hawaiian islands (Hansen 1995), Ghana (Smetana 1978) and Sri Lanka (Hansen 1995). All specimens but one examined by us from the West Indian islands were females. The only male known from the West Indies is from Puerto Rico.

**Habitat.** Specimens of *O. sharpi* are often collected from dry leaf litter of secondary forests or other secondary types of vegetation (including bamboo stands in agricultural areas), and are also found in cow and horse dung in the lowlands or occasionally attracted to UV light.

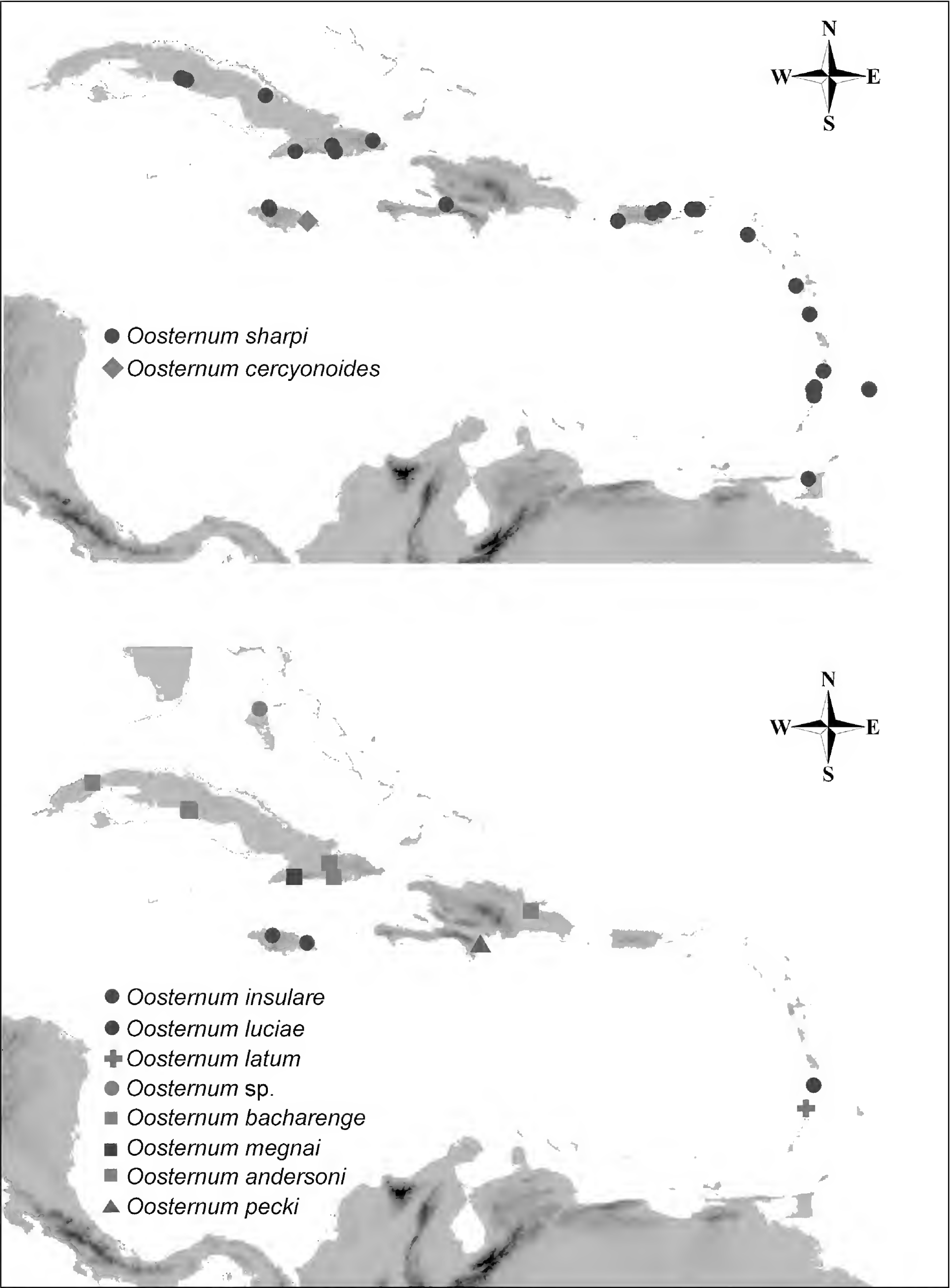
### *Oosternum* sp.

Figs 34, 48

**Material examined** (1 spec.): **BAHAMAS:** Andros Island, Forfar Field Station, 10 m, 24°53'50.81"N, 77°55'54.29"W, 10/15.vii.1983, J. Peacock leg., at light (1 spec., WIFP).

**Diagnosis.** Body widest ca at midlength. Lateral margin of pronotum angulate. Pronotal punctation double-sized, dense consisting of moderately large, round punctures intermixed with smaller transverse punctures. Pronotal interstices with microsculpture. Lateral margin of antennal grooves with acute projection. Elytral interval 2 narrower than interval 3, lower than intervals 1 and 3, reaching elytral apex. Elytral intervals 5, 7 and 9 distinctly higher than adjacent intervals. Elytral interstices shiny, without microsculpture. Preepisternal plate wide, drop-like, 2× longer than wide. Interstices of median part of metaventrite with very fine microsculpture, opaque. Anterolateral ridges of metaventrite not meeting together mesally, indistinct laterally.

**Comment.** The single examined specimen is very similar to *O. sharpi* but differs from it by the relatively smaller preepisternal plate of the mesothorax, central portion of the metaventrite with much finer punctation and the



**Figure 61.** Distribution of the representatives of the *Oosternum* from West Indies. Shape of the symbols indicate the species group which the respective species belongs to (see the Discussion for details).

laterally incomplete anterolateral ridge (Fig. 48). However, since only a single female is available, we refrain from describing it as a new species, pending the discovery of additional specimens and ideally males.

## Discussion

### Composition of the West Indian fauna of *Oosternum*.

Ten species groups of *Oosternum* were defined by Fikáček et al. (2009), using a set of arbitrarily selected characters (prosternal morphology, the form the pronotum, elytral morphology and the morphology of the metaventricle). These groups were aimed to divide the genus into smaller parts facilitating the species-level revision. Their phylogenetic significance has never been tested, yet they are the only available proxy of the internal structure of *Oosternum* at the moment. Moreover, additional characters exclusively correlating with some of the groups or their combinations were subsequently found (Fikáček 2009), which possibly indicates that at least some of these groups are candidates for monophyletic clades.

Representatives of five different species groups were found in the West Indies. Four species, the widely distributed *O. sharpi*, the endemic *O. insulare* and *O. luciae*, and the undescribed species from the Bahamas, are members of the *O. sharpi* species group (indicated by circles in Fig. 61). One species, *O. latum*, is a member of the *O. aequinoctiale* group (Fikáček et al. 2009; cross-shaped symbol in Fig. 61), which seems to be morphologically very close to the *O. sharpi* group based on the medially differentiated prosternum, pronotal punctation consisting of two intermixed types of punctures (one with long seta, one with extremely reduced seta) and antennal grooves with acute lateral projection. Further five species represent the groups without differentiated median portion of prosternum. They key out as members of *Oosternum* group C (in case of *O. cercyonoides*) and of the *O. pubescens* group (in case of *O. andersoni*, *O. bacharenge*, *O. megnai* and *O. pecki*) using the key to groups by Fikáček et al. (2009), as they differ in the morphology of the elytral intervals. However, the close relationship of the West Indian species with *O. pubescens* (LeConte, 1855) seems rather improbable, as the latter species is unique among *Oosternum* by possessing a partially differentiated median portion of prosternum (see Fig. 250 in Smetana 1978, under the name *Cercyon pubescens*). In contrast, all West Indian species bear a simply carinate prosternum. Moreover, *O. pecki* seems rather isolated from the remaining West Indian species based on its unique morphology of the meso- and metaventricle (preepisternal plate largely overlapping over metaventricle, metaventricle with an additional lateral ridge along the lateral margin) as well as by the character of the pronotal punctation (shape of the punctures changes from anterior margin to the posterior one). We therefore tentatively consider the West Indian species with simple prosternum as members of three species groups: *O. cercyonoides* and *O. pecki* each represent

a separate species group (marked by a rhomboid and a triangle in Fig. 61, respectively), whereas *O. andersoni*, *O. bacharenge* and *O. megnai* are extremely similar to each other and form the group depicted by squares in Fig. 61.

**Biogeography of the West Indian *Oosternum*.** Nine of the ten *Oosternum* species occurring in the West Indies are thus far endemic to the region. All of them are single-island endemics. The highest diversity is found in the Greater Antilles, where six endemic species were found, two on each island (Cuba, Jamaica, Hispaniola) except for Puerto Rico, from where no endemic species is known. In the Lesser Antilles, only two endemic species are known from the southern part of the island arc; one from each Saint Lucia and Saint Vincent islands.

Based on the assignment to the tentative species groups discussed above, the fauna of the Greater Antilles clearly shows a composite character, hosting representatives of five different species groups. Each Jamaican endemic species belongs to a different species group, and the same is the case of Hispaniola. This seems to indicate that the fauna of these islands resulted from multiple independent colonizations. A different situation is found in Cuba, where both endemic species, *O. andersoni* and *O. megnai*, are morphologically very similar and very likely closely related. They are moreover very similar to *O. bacharenge* from Hispaniola. It is hence probable that the three species are closely related. The geological block that today forms the northern part of Hispaniola was originally connected to that of eastern Cuba until the Early to Middle Miocene when it separated (Graham 2003). Hence, *Oosternum bacharenge* may have originated by vicariance after the separation of northern Hispaniola from Cuba. In Cuba, the two endemic species were never collected syntopically: *Oosternum andersoni* is a highland species widespread throughout the island, whereas *O. megnai* is endemic to the western part of the Sierra Maestra Mts. The type locality lies at the slope of Pico Turquino, i.e. the highest Cuban mountain. We failed to find the species in the central and eastern parts of Sierra Maestra despite our recent intensive collecting effort in these areas, which confirms that *O. megnai* is very likely a very local endemic. To understand the reasons for the within island split of *O. andersoni* and *O. megnai*, it would be necessary to date the age of the split. However, a local split along the elevation gradient seems currently as the most probable explanation.

Although data from other islands of the Greater Antilles are more limited than those from Cuba, the separation along the altitudinal gradient is likely also present in Jamaica, where *O. cercyonoides* is known from the highest mountain range only (Blue Mountains in eastern Jamaica, the type locality at 1600 m a.s.l.), whereas *O. insulare* is known from localities at around 500 m a.s.l. across the island. In this case, the species are however not related to each other, but the different environmental requirements may have facilitated their coexistence in the island after two independent colonizations. The composite character of the Hispaniolan fauna may on the other hand reflect

the composite geological origin of the island. The current island consists of two originally separate blocks. The northern one was connected to eastern Cuba until the Early/Middle Miocene (as discussed above), whereas the southern one originally formed a separate island and was connected with the northern one in the Middle Miocene (Graham 2003). One Hispaniolan endemic species is known from the former northern island (*O. bacharenge*), the other from the former southern island (*O. pecki*) and they are moreover not closely related to each other. The probable origin of *O. bacharenge* was already discussed. *Oosternum pecki* may have originally been the sole endemic in the small island of Southern Hispaniola, resulting from the dispersal from the continent or another West Indian island.

The endemics of the Lesser Antilles are most probably not closely related, and are both known from the volcanic island in the south of the island arc (*O. luciae* from St. Lucia, *O. latum* from St. Vincent), i.e. those which are rather close to the South American continent. The taxonomy and distribution is known in detail at least for the *O. aequinoctiale* group to which *O. latum* belongs. All species of this group but *O. latum* are restricted to South and Central America, and none of them, including the otherwise very widespread *O. aequinoctiale* (Motschulsky, 1855), does not occur in the West Indies (Fikáček et al. 2009). It seems hence probable that *O. latum* colonized the volcanic island of St. Vincent from South America. Same may be true for *O. luciae* which also has its relative species only in South America (Fikáček, unpubl. data) and is not related to any other West Indian species.

**Unbalanced sex ratio of West Indian populations of *O. sharpi*?** *Oosternum sharpi* is the only species of the genus that is widespread in the West Indies and also the only one that is not endemic – it is also widespread in the continental Central and South America and in the southern USA (this material was not studied in detail in this study). Surprisingly, the vast majority of the West Indian specimens of this species examined by us (64 of 65 specimens) are females. No males were found in most islands, with the only exception of Puerto Rico, from which the only West Indian male of the species is known. Even through this may be accidental due to a small number of specimens collected in most collecting events, it still stands in contrast to most other West Indian *Oosternum* species treated here in which males were found despite the limited number of collected specimens. It is also in a strong contrast to the continental populations of *O. sharpi*, in which males are frequent (M. Fikáček, unpubl. data). Additional collecting is needed to test whether the absence of males in most islands is just a collecting bias, or whether some island population of *O. sharpi* may be parthenogenetic. The latter possibility would however correspond with the wide distribution of the species in the West Indies as well as with the fact that *O. sharpi* is the only species of the genus which was introduced outside of the Neotropical Region (as a single female is able to establish a new population in parthenogenetic species).

## Acknowledgements

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## References

- Anderson RS, Ashe JS (2000) Leaf litter inhabiting beetles as surrogates for establishing priorities for conservation in selected tropical montane cloud forests in Honduras, Central America (Coleoptera: Staphylinidae, Curculionidae). *Biodiversity and Conservation* 9(5): 617–653. doi: 10.1023/A:1008937017058
- Bond J (1993) *The Birds of the West Indies*. 5th ed. Houghton Mifflin, Boston, 256 pp.
- Cala-Riquelme F (2013) First record of the jumping spider *Habronatus mexicanus* (Peckham & Peckham, 1901) (Salticidae: Plexipoidae: Pelleninae) from Cuba. *Peckhamia* 109.1: 1–3.
- Cala-Riquelme F, Agnarsson (in press) I New species of *Otiotrops* MacLeay (Araneae: Palpimanidae: Otiotropsinae) from Cuba. *Bulletin of the British Arachnological Society*.
- CENAP (2004) *Áreas protegidas de Cuba*. Ministerio de Ciencia, Tecnología y Medio Ambiente, 112 pp.
- Deler-Hernández A, Cala-Riquelme F, Fikáček M (2013) Description of a new species of *Phaenonotum* from eastern Cuba (Coleoptera: Hydrophilidae: Sphaeridiinae). *Acta Entomologica Musei Nationalis Pragae* 53(2): 615–622.
- Fikáček M (2009) Taxonomic revision of New World species of the genus *Oosternum* Sharp. III. A new species of *O. aequinoctiale* species group from Costa Rica (Hydrophilidae: Sphaeridiinae: Megasternini). *Koleopterologische Rundschau* 79: 179–187.
- Fikáček M, Hebauer F (2009) Taxonomic revision of New World species of the genus *Oosternum* Sharp, 1882 (Coleoptera: Hydrophilidae: Sphaeridiinae) II. The *O. convexum* species group. *Acta Entomologica Musei Nationalis Pragae* 49(1): 103–117.
- Fikáček M, Hebauer F, Hansen M (2009) Taxonomic revision of New World species of the genus *Oosternum* Sharp, 1882 (Coleoptera: Hydrophilidae: Sphaeridiinae) I. Definition of species groups and revision of *O. aequinoctiale* species group. *Zootaxa* 2054: 1–37.
- Graham A (2003) Geohistoric models and Cenozoic paleoenvironments of the Caribbean Region. *Systematic Botany* 28(2): 378–386.
- Hansen M (1995) A Review of the Hawaiian Hydrophilidae (Coleoptera). *Pacific Science* 49(3): 266–288.



- Hansen M (1999) Taxonomic changes in the genera *Oosternum* Sharp and *Paroosternum* Scott (Coleoptera: Hydrophilidae). *Entomologica Scandinavica* 30: 241–242. doi: 10.1163/187631200X00084
- Leach WE (1817) The zoological miscellany. Vol. 3. R. P. Nodder, London, 151 pp., pl. 121–150.
- LeConte JL (1855) Synopsis of the Hydrophilidae of the United States. *Proceeding of the Academy of Natural Sciences of Philadelphia* 7: 356–375.
- Makhan D (2009) *Motonerus amrishi* sp. n. and *Motonerus rishwani* sp. n. from Suriname (Coleoptera: Hydrophilidae: Sphaeridiinae). *Calodema* 107: 1–3.
- Mittermeier RA, Gil PR, Pilgrim J, Brooks T, Mittermeier CG, Da Fonseca GAB, Ford H, Seligmann-Smith PA (2005) Hotspots revisited: Earth's biologically richest and most endangered terrestrial ecoregions. Conservation International, Washington, DC, 329.
- Motschulsky V (1855) Lettre de M. de Motschulsky à M. Ménétries. In: *Etudes Entomologiques*. Société de Littérature Finnoise, Helsingfors. Vol. 4, 84 pp., 1 pl. 8–25.
- Orchymont A. d' (1940) Les Palpicornia des îles atlantiques. *Mémoires du Musée Royal d'Histoire Naturelle de Belgique*, 2ème Série 20: 1–86.
- Peck SB (2005) A checklist of the beetles of Cuba with data on distribution and bionomics (Insecta: Coleoptera). *Arthropods of Florida and Neighbouring Land Areas* 18: 1–241.
- Sharp D (1882) *Insecta: Coleoptera*. Vol. 1. Part 2 (Halplidae, Dytiscidae, Gyrinidae, Hydrophilidae, Heteroceridae, Parnidae, Georissidae, Cyathoceridae, Staphylinidae). In: Godman FC, Salvin O (Eds) *Biologia Centrali-Americana*. Volume 16. Taylor & Francis, London, i–xv + 1–144.
- Short AEZ, Fikáček M (2011) World catalogue of the Hydrophiloidea (Coleoptera): additions and corrections II (2006–2010). *Acta Entomologica Musei Nationalis Pragae* 51(1): 83–122.
- Smetana A (1978) Revision of the subfamily Sphaeridiinae of America north of Mexico (Coleoptera: Hydrophilidae). *Memoirs of the Entomological Society of Canada* 105: 1–292. doi: 10.4039/entm110105fv
- Spangler PJ (1981) Supplement to the aquatic and semiaquatic Coleoptera of Cuba collected by the Biospeleological Expeditions to Cuba by the Academies of Science of Cuba and Romania. *Résultats des Expéditions Biospéologiques Cubano-Roumaine a Cuba* 3: 145–171.
- Svensson BW (1973) Report no 63 from the Lund University Expeditions in 1957 to the Azores and Madeira. *Palpicornia* (Coleoptera) from the Azores. *Boletim do Museu Municipal do Funchal* 27: 90–93.





# Taxonomic revision of the cryptic ant genus *Probolomyrmex* Mayr (Hymenoptera, Formicidae, Proceratiinae) in Madagascar

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<http://zoobank.org/8F1433EB-EF78-4277-B0B6-CF4E227D4642>

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## Abstract

The alpha taxonomy of the ant genus *Probolomyrmex* in Madagascar is revised on the basis of the worker caste. Two new species are described: *P. curculiformis* **sp. n.** and *P. zahamena* **sp. n.** and the previously known *P. tani* is re-described. All three species are members of the *P. greavesi* species group. The species descriptions include diagnoses, taxonomic discussions, high quality montage images, and distribution maps. In addition, we provide an illustrated species level identification key.

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## Key Words

Malagasy region

Proceratiinae

*Probolomyrmex*

*P. greavesi* species group

taxonomy

## Introduction

The rare ant genus *Probolomyrmex* is distributed throughout most of the world's tropics and subtropics, and contains 24 valid species at present (Bolton 2014). Based on current knowledge, *Probolomyrmex* are cryptic ants that live in small (around 20 workers), subterranean colonies in a variety of forest habitats (Taylor 1965, Shattuck et al. 2012). If encountered alive in the field they move very fast in straight movements with stretched out antennae (Agosti 1994). Due to their cryptic lifestyle they are seldom collected and only very little information about the biology of these peculiar ants exists (Taylor 1965, Agosti 1994, Shattuck et al. 2012). The Oriental species *P. dammermani* Wheeler turned out to be a specialised predator of polixenid millipeds (Ito 1998), but whether this prey

choice is universal within *Probolomyrmex* or restricted only to *P. dammermani* remains to be studied.

The taxonomy of the genus is in a fairly good condition. Taylor (1965) monographed the genus, provided a global taxonomic revision and recognized nine species. Since then a number of authors published isolated species descriptions and updated, taxonomic revisions for several regional faunas (Neotropical: Agosti 1994, O'Keefe and Agosti 1997, Oriental: Tanaka 1974, Terayama and Ogata 1988, Xu and Zeng 2000, Eguchi et al. 2006, Malagasy: Fisher 2007, Australia and Melanesia: Shattuck et al. 2012). Recently, Eguchi et al. (2006) tried to divide the genus into smaller subsets for the Oriental and Indo-Australian regions and created two species groups: the *P. longinodus* group, which is characterised by a low, long petiole with reduced subpetiolar process,

and the *P. greavesi* group, which contains species with a stouter petiole with very well developed subpetiolar process. Until a few years ago *Probolomyrmex* was unknown from the Malagasy region. Fisher (2007) provided the first record and described the first species from Madagascar: *P. tani* Fisher. Despite not having been associated to any species group yet, *P. tani* can be placed in the *P. greavesi* species group sensu Eguchi et al. (2006) on the basis of the only slightly longer than high petiole with well-developed ventral process.

In this study we revise the alpha taxonomy of the ant genus *Probolomyrmex* for Madagascar. We describe the two new species *P. curculiformis* and *P. zahanena* and re-describe *P. tani*. All descriptions include diagnoses, taxonomic discussions, and high quality montage images. In addition, we provide an illustrated identification key to species, as well as maps showing the known distribution ranges.

### Abbreviations of depositories

The collection abbreviations follow Evenhuis (2014). The material upon which this study is based is located and/or was examined at the following institutions:

- BMNH The Natural History Museum (British Museum, Natural History), London, U.K.  
 CASC California Academy of Sciences, San Francisco, California, U.S.A.  
 MCZC Museum of Comparative Zoology, Cambridge, Massachusetts, U.S.A.

### Material and methods

The material examined in this study is based on ant inventories carried out on Madagascar from 1992 to 2011 which included more than 6,000 leaf litter samples, 4,000 pitfall traps, and 9,000 additional hand collecting events (see Fisher 2005 for additional details). Despite such an intensive sampling effort throughout the whole island, *Probolomyrmex* ants were only rarely collected. This is reflected in the just 40 specimens available for this study.

All new type material and all imaged specimens can be uniquely identified with specimen-level codes affixed to each pin (e.g. CASENT0078328). In the presented descriptions we list all of the available specimen-level codes for the whole type series. It should be noted, however, that the number of stated paratype workers does not necessarily match the number of listed specimen-level codes because pins can hold more than one specimen. Digital colour images were created using a JVC KY-F75 digital camera and Syncroscopy Auto-Montage software (version 5.0), or a Leica DFC 425 camera in combination with the Leica Application Suite software (version 3.8). All images presented are available online and can be seen on AntWeb (<http://www.antweb.org>). The distribution maps provided at the end of the study (Fig. 6)

were generated with the software R (R Core Team 2014). The measurements were taken with a Leica MZ 12.5 equipped with an orthogonal pair of micrometers at a magnification of 100×. Measurements and indices are presented as minimum and maximum values with arithmetic means in parentheses. In addition, all measurements are expressed in mm to two decimal places. The measurements and indices used in this study are mostly based on Taylor (1965), Eguchi et al. (2006), Fisher (2007), and Shattuck et al. (2012):

- HL** Head length: in full-face view maximum longitudinal length of head from anterior-most portion of projecting clypeus to midpoint of line across back of head  
**HW** Head width: in full-face view maximum width of head  
**SL** Scape length: maximum length of antennal scape excluding basal constriction and condylar bulb  
**WL** Weber's length: diagonal length of mesosoma measured in profile from posteroventral corner of mesosoma to the farthest point on anterior face of pronotum, excluding the neck  
**PH** Pronotum height: maximum height of pronotum in lateral view  
**PW** Pronotum width: maximum width of pronotum in dorsal view  
**HTL** Length of the hind tibia: measured in dorsolateral view, from the articulation with the femur, excluding the proximomedial condyle, to the distal extremity of the tibia  
**PeW** Dorsal petiolar width: maximum width of the petiole in dorsal view  
**PeH** Petiole height: height of petiole in lateral view, measured vertically from the ventral margin of the posteroventral convexity/angle/projection of subpetiolar process to the level of the highest point of petiolar node  
**PeNH** Petiolar node height: maximum height of petiolar node in lateral view, measured vertically from a line tangent to the posterior and anterior-most points of the tergosternal suture to the level of the highest point on the node  
**PeNL** Petiole node length: in dorsal view, maximum length of the node, measured from the anterior margin of the node (excluding articulation with propodeum) to the posteriormost dorsal margin of node. If anterior or posterior margin is concave, the length is measured from the midpoint of a line drawn across the margin  
**CI** Cephalic index:  $HW/HL \times 100$   
**SI** Scape index:  $SL/HW \times 100$   
**LMI** Lateral mesosoma index:  $PH / WL \times 100$   
**HTLI** Hind tibial length index:  $HTL / HW \times 100$   
**DPeI** Dorsal petiolar node index:  $PeW/PeNL \times 100$   
**PeNI** Dorsal petiole index:  $PeW/PW \times 100$   
**LPeI** Lateral petiolar index:  $PeNL/PeH \times 100$   
**LPeNI** Lateral petiolar node index:  $PeNL/PeNH \times 100$

## Taxonomy

### Genus *Probolomyrmex* Mayr

<http://species-id.net/wiki/Probolomyrmex>

*Probolomyrmex* Mayr 1901: 2. Type species: *Probolomyrmex filiformis* Mayr, by monotypy.

*Escherichia* Forel 1910: 245. Type species: *Escherichia brevirostris* Forel, by monotypy. [synonymised by Taylor 1965: 346]

**Notes.** Detailed diagnoses were given by Taylor (1965), Bolton (2003), Eguchi et al. (2006), and Keller (2011). The material from Madagascar treated herein matches them almost perfectly with one exception. The lack of any sutures or grooves on the mesosoma of *Probolomyrmex* is a widely accepted genus-specific character, but we observed the presence of a small but noticeable metanotal groove in two of the three Malagasy species. *Probolomyrmex* ants are always easily recognisable from other ants on the basis of their long and slender bodies, almost complete lack of pilosity, the long sting, and especially the fronto-clypeal shelf bearing the antennal insertions (Taylor 1965, Agosti 1994). Taylor (1965) pointed out that the structural reduction in *Probolomyrmex* is extreme, which leaves only a few, useful diagnostic characters, such as dimensions and proportions of head, antennae, petiole, as well as surface sculpture. Based on the material from Madagascar, however, we do not consider surface sculpture

to be too important for species diagnostics. We observed some noticeable variation within species. Consequently, we tried to avoid using surface sculpture as primary diagnostic character, and used it only as supporting character.

All three species treated in this study are placed in the *P. greavesi* species group sensu Eguchi et al. (2006), mostly on the basis of the well-developed ventral process. The two species groups hypothesised by Eguchi et al. (2006) work very well for the Oriental and Indo-Australian regions, and there is no reason to create a new group for the three species from Madagascar. As already pointed out by Fisher (2007) for *P. tani*, the Afrotropical species, which can also be placed in the *P. greavesi* species group, appear morphologically close to the three species from Madagascar suggesting a close relationship. At the moment however, it is not possible to assess the phylogenetic relationships of the Malagasy species with the species from other regions in a comprehensive way due to the high morphological uniformity and lack of diagnostic characters. A highly desirable multi-gene molecular phylogenetic analysis might provide insights into the subgeneric relationships within *Probolomyrmex*.

### Synoptic list of *Probolomyrmex* species from Madagascar

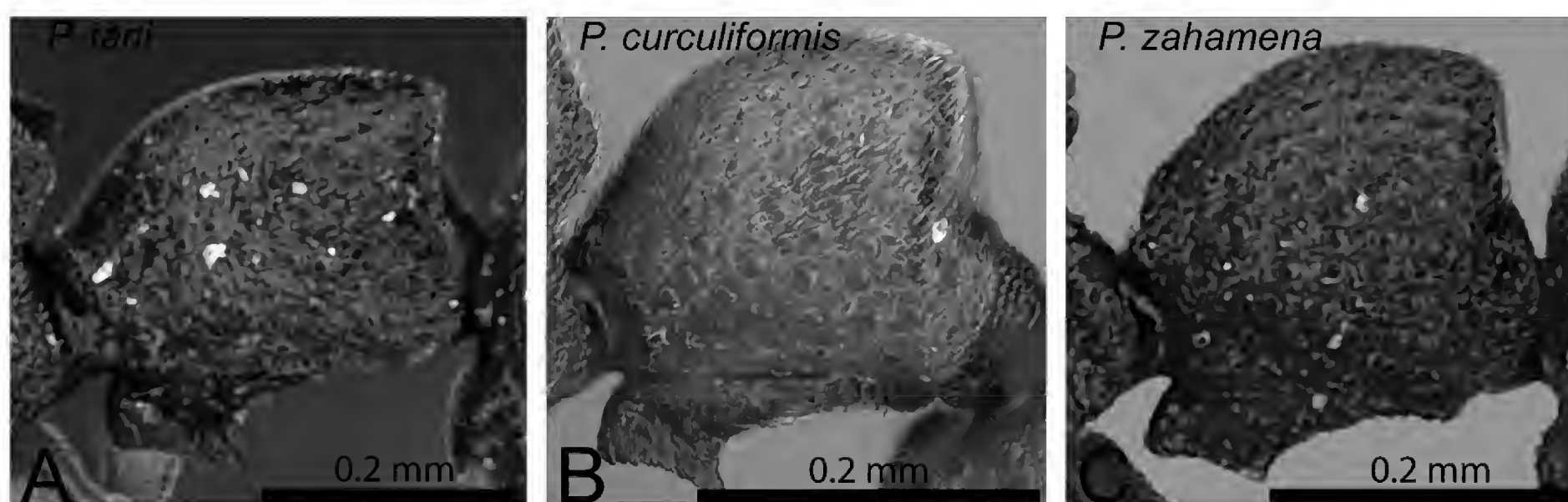
*Probolomyrmex curculiformis* Hita Garcia & Fisher, sp. n.

*Probolomyrmex tani* Fisher, 2007

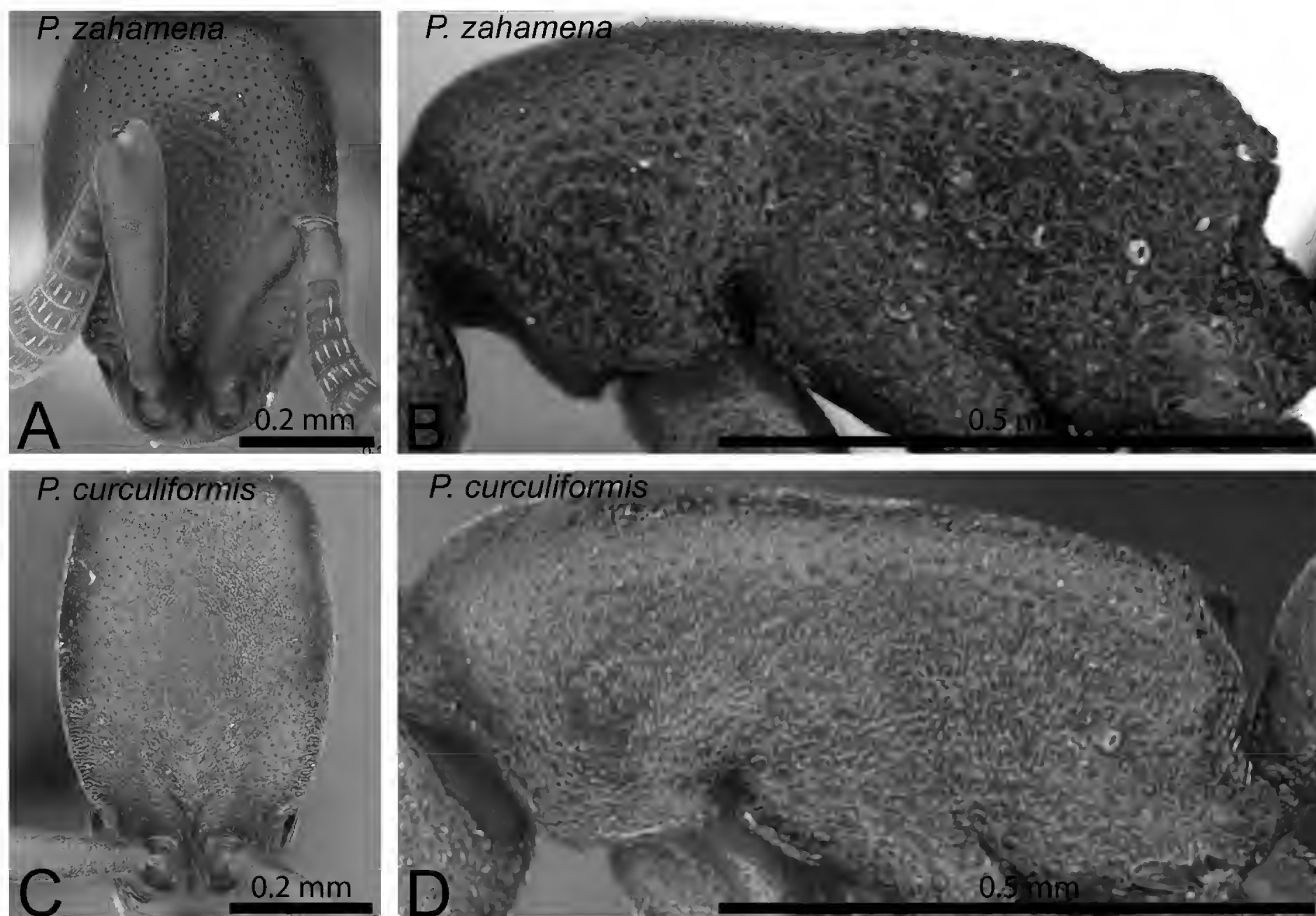
*Probolomyrmex zahamena* Hita Garcia & Fisher, sp. n.

### Identification key to *Probolomyrmex* species from Madagascar (workers)

- 1 Petiole relatively longer, lower, and less arched, in profile (without ventral process) around 1.3 to 1.5 times longer than high (LPNeI 127–150), and in dorsal view around 1.4 to 1.6 times longer than broad (DPeI 63–69) (Fig. 1A) ..... *P. tani*
- Petiole shorter, higher and stronger arched, in profile (without ventral process) between 1.0 to 1.2 times longer than high (LPNeI 103–116); in dorsal view petiole around 1.2 to 1.3 times longer than broad (DPeI 76–86) (Fig. 1B, C) .... 2
- 2 Head shorter, in full-face view around 1.4 to 1.5 times longer than broad (CI 67–70); antennal scapes longer (SI 99–102); mesosoma with weak but distinct metanotal groove; surface sculpture much stronger developed throughout whole body; body colour usually darker than above, usually dark, reddish brown (Fig. 2A, B) ..... *P. zahamena*
- Head longer, in full-face view around 1.5 to 1.6 times longer than broad (CI 62–65); antennal scapes shorter (SI 91–94); mesosomal outline straight without any groove; surface sculpture much weaker developed throughout whole body; body colour light orange brown (Fig. 2C, D) ..... *P. curculiformis*



**Figure 1.** Petiole in profile view. **A** *P. tani* (CASENT0243185) **B** *P. curculiformis* (CASENT0469570) **C** *P. zahamena* (CASENT0914279).



**Figure 2.** Head in full-face view and mesosoma in profile. **A, B** *P. zahamena* (CASENT0914279) **C, D** *P. curculiformis* (CASENT0469570).

***Probolomyrmex curculiformis* Hita Garcia & Fisher, sp. n.**

<http://zoobank.org/ABC95DCB-B3CF-428B-BE9F-D112B77D7159>

[http://species-id.net/wiki/Probolomyrmex\\_curculiformis](http://species-id.net/wiki/Probolomyrmex_curculiformis)

Figs 1B, 2C, D, 3C, 6

**Type material.** **Holotype**, pinned worker, MADAGASCAR, Mahajanga, Parc National d'Ankarafantsika, Ampijoroa Station Forestière, 5.4 km 331° NW Andranofasika, 16.29889°S, 46.813°E, 70 m, tropical dry forest, sifted litter (leaf mold, rotten wood), collection code BLF03571, 26.III.–1.IV.2001 (*Rabeson et al.*) (CASC: CASENT0469570). **Paratypes**, nine pinned workers with same data as holotype (BMNH: CASENT0469574; CASC: CASENT0469571; CASENT0469572; CASENT0469573; CASENT0469575; CASENT0469576; CASENT0469577; CASENT0469579; MCZ: CASENT0469578); and one pinned worker from Mahajanga, Parc National d'Ankarafantsika, Ampijoroa Station Forestière, 40 km 306° NW Andranofasika, 16.32083°S, 46.81067°E, 130 m, tropical dry forest, sifted litter (leaf mold, rotten wood), collection code BLF03522, 26.III.–1.IV.2001 (*B.L. Fisher et al.*).

**Non-type material.** MADAGASCAR: Antsirana, Forêt d'Anabohazo, 21.6 km 247° WSW Maromandia, 14.30889°S, 47.91433°E, 120 m, tropical dry forest, 11.–16.III.2001 (*B.L. Fisher et al.*) (CASC:

CASENT0458322; CASENT0458323); Mahajanga, Parc National d'Ankarafantsika, Ampijoroa Station Forestière, 40 km 306° NW Andranofasika, 16.32083°S, 46.81067°E, 130 m, tropical dry forest, 26.III.–1.IV.2001 (*B.L. Fisher et al.*) (CASC: CASENT0465467; CASENT0465863); Mahajanga, Forêt de Tsimembo, 8.7 km 336° NNW Soatana, 19.02139°S, 44.44067°E, 20 m, tropical dry forest, 21.–25.XI.2001 (*B.L. Fisher et al.*) (CASC: CASENT0080550); Mahajanga, Parc National Tsingy de Bemaraha, 3.4 km 93° E Bekopaka, Tombeau Vazimba, 19.14194°S, 44.828°E, 50 m, tropical dry forest, 6.–10.XI.2001 (*B.L. Fisher et al.*) (CASC: CASENT0477984; CASENT0477985; CASENT0477986); Toliara, Tulear, Berenty, 12 km N.W. Amboasary, 24.251889°S, 45.860894°E, 5.–15.V.1983 (*J.S. Noyes & M.C. Day*) (BMNH: CASENT0102226); Toliara, Parc National de Tsimanampetsotsa, Forêt de Bemanateza, 20.7 km 81° E Efoetse, 23.0 km 131° SE Beheloka, 23.99222°S, 43.88067°E, 90 m, 22.–26.III.2002 (*B.L. Fisher et al.*) (CASC: CASENT0004401).

**Diagnosis.** *Probolomyrmex curculiformis* is easily distinguishable from the other Malagasy congeners on the basis of the following character combination: head in full-face view around 1.5 to 1.6 times longer than broad (CI 62–65); SI 91–94; mesosomal outline straight without metanotal groove; hind tibia around 1.1 to 1.2 times



shorter than head width (HTLI 83–92); petiole shorter, higher and stronger arched, in profile (without ventral process) between 1.0 to 1.2 times longer than high (LPNeI 107–116), in dorsal view petiole around 1.2 to 1.3 times longer than broad (DPeI 76–82).

**Worker measurements (N=15).** HL 0.57–0.60 (0.59); HW 0.37–0.39 (0.38); SL 34–37 (0.35); WL 0.71–0.76 (0.74); PH 0.24–0.26 (0.25); PW 0.27–0.32 (0.30); HTL 0.32–0.35 (0.33); PeH 0.27–0.32 (0.29); PeNH 0.20–0.23 (0.21); PeNL 0.22–0.25 (0.24); PeW 0.18–0.19 (0.19); CI 62–65 (0.64); SI 91–94 (93); LMI 33–35 (0.34); HTLI 83–92 (88); DPeI 76–82 (79); LPeI 76–86 (80); LPeNI 107–116 (110); PeNI 60–67 (63).

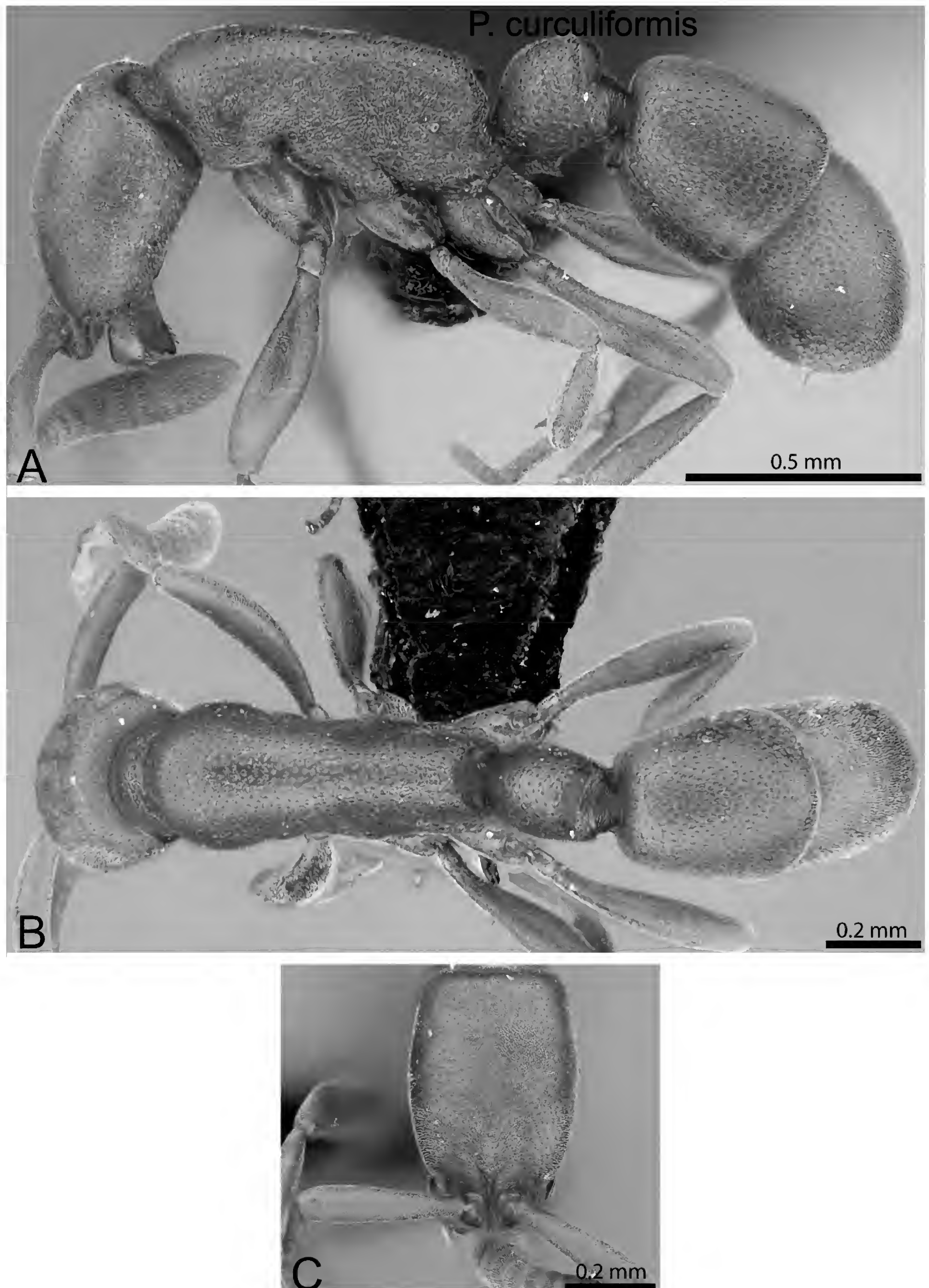
**Worker description.** In full-face view head between 1.5 to 1.6 times longer than broad (CI 62–65), posterior head margin more or less flat; lateral margins of head convex, broadest medially, posterolateral corners rounded; clypeus and anterior part of frons strongly protruding anteriorly as narrow frontoclypeal, subrectangular shelf or socket; antennal sockets exposed and closely approximated, separated by a thin, vertical lamella formed by fused frontal carinae; mandibles small, triangular to elongate-triangular, masticatory margin armed with one larger apical tooth and a series of six smaller denticles, in full-face view mandibles obscured by frontoclypeal shelf; palp formula 4,2; eyes absent; antennae 12-segmented, funicular antennomeres growing in size and width towards apex without forming well defined antennal club, apical antennomere much larger than remaining funicular antennomeres, antennal scape short (SI 91–94), far from reaching posterior head margin. Mesosoma slender, long, and relatively low (LMI 33–35), in profile mesosomal outline flat; propleurae enlarged and projecting ventrally; promesonotal suture and metanotal groove absent; declivitous face of propodeum margined by low, obtuse, and concave lamella on each side, propodeal lamella posterodorsally and posteroventrally with small, blunt tooth or rounded lobe; posterior declivity of propodeum weakly concave in dorsal view. Legs long and slender; all tibiae with single, pectinate spur; pretarsal claws simple without median tooth; hind tibia around 1.1 to 1.2 times shorter than head width (HTLI 83–92). In profile petiole with subpetiolar process around 1.2 to 1.3 times higher than long (LPeI 76–86), petiole without subpetiolar process around 1.1 to 1.2 times longer than high (LPNeI 107–116), petiolar dorsum strongly arched, much higher posteriorly, anterior face curving smoothly onto dorsum without well developed anterodorsal margin, posterior face vertical and concave, enclosed laterally and dorsally by low, thick carina; in dorsal view petiole around 1.3 to 1.3 times longer than broad (DPeI 76–82); pronotum between 1.5 to 1.7 times longer than petiolar width (PeNI 60–67); subpetiolar process well developed and lamelliform, ventral face weakly concave, anteroventral portion rounded to moderately angled, posteroventral portion sharper and stronger angled, projecting backwards, usually as small acute tooth. Abdominal segment III in profile narrowed anteriorly, broadest

posteriorly. Sting well developed and very long. Surface sculpture generally weakly to moderately foveolate overlaying conspicuous very fine, more or less dense, coriaceous microsculpture, usually foveolate sculpture better developed and more conspicuous on cephalic dorsum, lateral mesosoma, and lateral petiole than remainder of body. Pilosity strongly reduced throughout and virtually absent, except for few short hairs below frontoclypeal shelf, some longer hairs on mandibles, and some short, fine hairs around metapleural gland orifice. Pubescence whitish, extremely fine, very short, and appressed, present over most of body, funicular antennomeres with such pubescence overlaid by much scattered, much longer, appressed hairs. Colour dark reddish brown, appendages light brown. Pilosity strongly reduced throughout and virtually absent, except for few short hairs below frontoclypeal shelf, some longer hairs on mandibles, and some short, fine hairs around metapleural gland orifice. Pubescence whitish, extremely fine, very short, and appressed, present over most of body, funicular antennomeres with such pubescence overlaid by much scattered, much longer, appressed hairs. Colour orange to light brown, appendages yellowish.

**Etymology.** The name of the new species is a combination of the Latin noun “curculio”, which means weevil, and the suffix “formis”, which means alike. The long and narrow head with its anteriorly projecting frontoclypeal shelf resembles the elongated head shape of a weevil.

**Distribution and biology.** *Probolomyrmex curculiformis* is widely but patchily distributed in western Madagascar (Fig. 6). Its known distribution ranges from the southernmost localities Tsimanampetsotsa and Amboasary to Anabohazo in the northwest. The localities are all tropical dry forest or spiny forest habitats situated at very low elevations of 20 to 130 m. Even though the new species was entirely collected by sifting litter, we suspect it is not a genuine leaf litter inhabitant. Instead, *P. curculiformis* is likely to be a hypogaeic species and the available material was sampled accidentally through the collection of soil for leaf litter sifting. A hypogaeic lifestyle would also explain the patchy distribution pattern. If true, intensive soil sampling in western Madagascar will likely yield more material of this species. The natural history of *P. curculiformis* is unknown.

**Discussion.** *Probolomyrmex curculiformis* is unlikely to be confused with the other two Malagasy *Probolomyrmex* species. The shape of the petiole is fairly distinct and separates the western *P. curculiformis* from the northern *P. tani* since the latter species has a much lower and longer petiole than the first. The third species, *P. zahamena*, from eastern Madagascar shares a higher and stouter petiole with *P. curculiformis*. However, *P. zahamena* possesses a small, but distinct metanotal groove, which is absent in *P. curculiformis*. In addition, the two species also differ in head shape, which is slightly broader in *P. zahamena* (CI 67–70) than in *P. curculiformis* (CI 62–65). Nevertheless, the last difference is sometimes hard to observe and requires measuring.



**Figure 3.** *Probolomyrmex curculiformis* sp. n. holotype worker (CASENT0469570). **A** Body in profile **B** Body in dorsal view **C** Head in full-face view.

**Variation.** Despite a very broad distribution pattern in western Madagascar, we could not observe any significant intraspecific variation except for surface sculpture. There is some moderate variation in density and depth of foveolate sculpture throughout the material examined here. Some specimens display very little sculpture while sculpture is very well developed in others.

### *Probolomyrmex tani* Fisher, 2007

[http://species-id.net/wiki/Probolomyrmex\\_tani%5Caccording\\_to\\_Hita\\_Garcia\\_et\\_al\\_2014](http://species-id.net/wiki/Probolomyrmex_tani%5Caccording_to_Hita_Garcia_et_al_2014)

Figs 1A, 4, 6

*Probolomyrmex tani* Fisher 2007: 146.

**Type material.** **Holotype**, pinned worker, MADAGASCAR, Antsiranana, Forêt d'Analabe, 30.0 km 72° ENE Daraina, 13.08333°S, 49.90833°E, 30 m, littoral rainforest, collection code BLF9426, 27.XI.2003 (*B.L. Fisher et al.*) (CASC: CASENT0041505). **Paratypes**, one pinned worker (CASC: CASENT0041507) and one dealate queen (CASC: CASENT0041506) with same data as holotype.

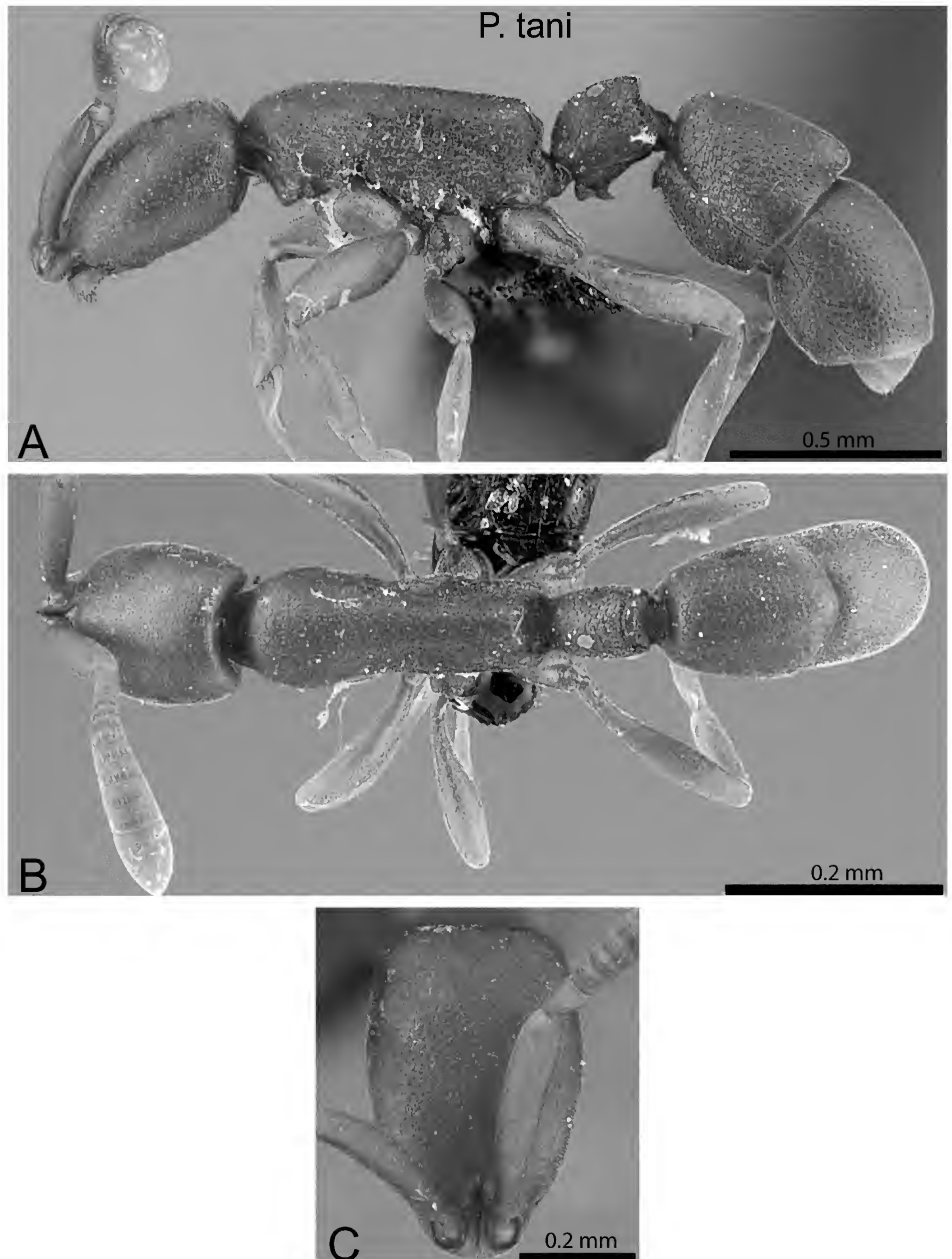
**Non-type material.** MADAGASCAR: Antsiranana, Ambondrobe, 41.1 km 175° Vohemar, 13.71533°S, 50.10167°E, 10 m, littoral rainforest, 29.XI.2004 (*B.L. Fisher*) (CASC: CASENT0056575; CASENT0057032); Antsiranana, Forêt de Binara, 9.4 km 235° SW Daraina, 13.26333°S, 49.6°E, 1100 m, montane rainforest, 5.XII.2003 (*B.L. Fisher*) (CASC: CASENT0043467; CASENT0043468; CASENT0043471); Antsiranana, Montagne des Français, 7.2 km 142° SE Antsiranana, 12.32278°S, 49.33817°E, 180 m, tropical dry forest, 22.–28.II.2001 (*B.L. Fisher et al.*) (CASC: CASENT0004400); Antsiranana, Makirovana forest, 14.16666°S, 49.95°E, 715 m, rainforest, 1.–2.V.2011 (*B.L. Fisher et al.*) (CASC: CASENT0243171; CASENT0243185); Antsiranana, Makirovana forest, 14.17066°S, 49.95409°E, 225 m, rainforest, 4.–6.V.2011 (*B.L. Fisher et al.*) (CASC: CASENT0231492).

**Diagnosis.** The following character set distinguishes *P. tani* from its congeners in Madagascar: head in full-face view between 1.5 to 1.6 times longer than broad (CI 64–66); SI 92–103; in profile mesosomal outline flat to very weakly convex, metanotal groove usually absent, but rarely weakly developed; hind tibia around 1.0 to 1.1 times longer than head width (HTLI 100–111); petiole relatively longer, lower, and less arched, in profile (without ventral process) around 1.3 to 1.5 times longer than high (LPNeI 127–150), and in dorsal view around 1.4 to 1.6 times longer than broad (DPeI 63–69).

**Worker measurements (N=10).** HL 0.56–0.65 (0.60); HW 0.37–0.42 (0.39); SL 35–43 (0.39); WL 0.73–0.91 (0.80); PH 0.25–0.30 (0.27); PW 0.27–0.35 (0.30); HTL 0.39–0.47 (0.42); PeH 0.26–0.31 (0.28); PeNH 0.19–0.23 (0.21); PeNL 0.26–0.34 (0.29); PeW 0.17–0.22 (0.19); CI 64–66 (65); SI 92–103 (0.98); LMI 33–37 (35); HTLI 100–111 (104); DPeI 63–69 (67); LPeI 97–110 (103); LPeNI 127–150 (137); PeNI 60–66 (63).

**Worker description.** In full-face view head between 1.5 to 1.6 times longer than broad (CI 64–66), posterior head margin flat or weakly concave; lateral margins of head convex, broadest medially, posterolateral corners rounded; clypeus and anterior part of frons strongly protruding anteriorly as narrow frontoclypeal, subrectangular shelf or socket; antennal sockets exposed and closely approximated, separated by a thin, vertical lamella formed by fused frontal carinae; mandibles small, triangular to elongate-triangular, masticatory margin armed with one larger apical tooth and a series of six smaller denticles, in full-face view mandibles obscured by frontoclypeal shelf; palp formula 4,2; eyes absent; antennae 12-segmented, funicular antennomeres growing in size and width towards apex without forming well defined antennal club, apical antennomere much larger than remaining funicular antennomeres, antennal scape short (SI 92–103), far from reaching posterior head margin. Mesosoma slender, long, and relatively low (LMI 33–37), in profile mesosomal outline flat to very weakly convex; propleurae enlarged and projecting ventrally; promesonotal suture absent; metanotal groove usually absent, rarely present but very weak; declivitous face of propodeum margined by low, obtuse, and concave lamella on each side, propodeal lamella posterodorsally with small, blunt tooth, posteroventrally with rounded lobe or very blunt tooth; posterior declivity of propodeum weakly concave in dorsal view. Legs long and slender; all tibiae with single, pectinate spur; pretarsal claws simple without median tooth; hind tibia around 1.0 to 1.1 times longer than head width (HTLI 100–111). In profile petiole with subpetiolar process around 1.0 to 1.1 times longer than high (LPeI 97–110), petiole without subpetiolar process around 1.3 to 1.5 times longer than high (LPNeI 127–150), petiolar dorsum strongly arched, much higher posteriorly, anterior face curving smoothly onto dorsum without well developed anterodorsal margin, posterior face vertical and concave, enclosed laterally and dorsally by low, thick carina; in dorsal view petiole around 1.4 to 1.6 times longer than broad (DPeI 63–69); pronotum between 1.5 to 1.7 times longer than petiolar width (PeNI 60–66); subpetiolar process well developed and lamelliform, ventral face weakly concave, anteroventral portion rounded to moderately angled, posteroventral portion sharper and stronger angled, projecting backwards, variably developed, ranging from right angle to a elongate-triangular tooth. Abdominal segment III in profile narrowed anteriorly, broadest posteriorly. Sting well developed and very long. Surface sculpture generally weakly to moderately foveolate overlaying conspicuous very fine, more or less dense, coriaceous microsculpture, foveolate sculpture better developed and more conspicuous on cephalic dorsum and lateral mesosoma than remainder of body. Pilosity strongly reduced throughout and virtually absent, except for few short hairs below frontoclypeal shelf, some longer hairs on mandibles, and some short, fine hairs around metapleural gland orifice. Pubescence whitish, extremely fine, very short, and appressed, present over most of body, funicular an-





**Figure 4.** *Probolomyrmex tani* holotype worker (CASENT0041505). **A** Body in profile **B** Body in dorsal view **C** Head in full-face view.

tenomeres with such pubescence overlaid by much scattered, much longer, appressed hairs. Colour light reddish brown to darker brown, appendages lighter, yellowish to light brown.

**Distribution and biology.** It has to be pointed out that *P. tani* is much less broadly distributed as previously thought. Indeed, its distribution is restricted to a narrow strip in the northeast of Madagascar ranging from Makirovana and Ambondrobe north to Montagne des Français. Most of the remaining locality data listed under *P. tani* in the original description (Fisher 2007) are actually records of the new species *P. curculiformis*, except for Manongarivo. The only available specimen from the latter locality is damaged, and it cannot be assigned to any species. Therefore, we do not list this locality for *P. tani* nor any of the other two species treated here. *Probolomyrmex tani* is found in a variety of forest habitats, such as littoral rainforest, tropical dry forest, lowland rainforest, and montane rainforest, and has an altitudinal range of 10 to 1100 m. Despite that most of the material was collected from leaf litter, *P. tani* is more likely subterranean in lifestyle, very much like *P. curculiformis*.

**Discussion.** *Probolomyrmex tani* is the most distinctive species of the three treated herein. The shape of the petiole alone separates it very well from *P. curculiformis* and *P. zahamena*. In these two the petiole is shorter, higher and stronger arched, in profile (without ventral process) around 1.3 to 1.5 times longer than high (LPNeI 127–150), and in dorsal view around 1.4 to 1.6 times longer than broad (DPeI 63–69). By contrast, the petiole of *P. tani* is relatively longer, lower, and less arched, in profile (without ventral process) around 1.3 to 1.5 times longer than high (LPNeI 127–150), and in dorsal view around 1.4 to 1.6 times longer than broad (DPeI 63–69).

**Variation.** Despite being less variable than previously thought (Fisher 2007), *P. tani* still displays some noticeable intraspecific variation within a relatively small area in northern Madagascar. The specimens from Makirovana possess a much better developed and conspicuous foveolate surface sculpture than the rest of the material of *P. tani*. Most of the material from Makirovana also has a small but distinct metanotal groove, which is absent in the material from other localities, and longer antennal scapes (SI 99–102). These dissimilarities could be used to separate this series as different species. However, there are several good arguments against it. The length of the antennal scapes is always stable within localities, but shows some noticeable geographical variation. The specimens from the type locality possess the shortest scapes (SI 92–94), whereas the ones from Makirovana and Ambondrobe have the longest scapes (SI 99–102). However, the material from Binara and Montagne des Français shows intermediate values (SI 94–96). Furthermore, the metanotal groove is extremely weak in one specimen from Makirovana, almost absent. Also, as mentioned above, surface sculpturing is relatively variable in all three *Probolomyrmex* species. So, consequently, we prefer to keep all the material listed as *P. tani* as one somewhat variable species.

### *Probolomyrmex zahamena* Hita Garcia & Fisher, sp. n.

<http://zoobank.org/AD486A8E-1021-41F3-9AFE-AAAE7582E7E6>

[http://species-id.net/wiki/Probolomyrmex\\_zahamena](http://species-id.net/wiki/Probolomyrmex_zahamena)

Figs 1C, 2A, B, 5, 6

**Type material.** **Holotype**, pinned worker, MADAGASCAR, Toamasina, Parc National de Zahamena, Onibe River, 17.75908°S, 48.85468°E, 780 m, rainforest, sifted litter (leaf mold, rotten wood), collection code BLF22214, 21.–23.II.2009 (*B.L. Fisher et al.*) (CASC: CASENT0914279).

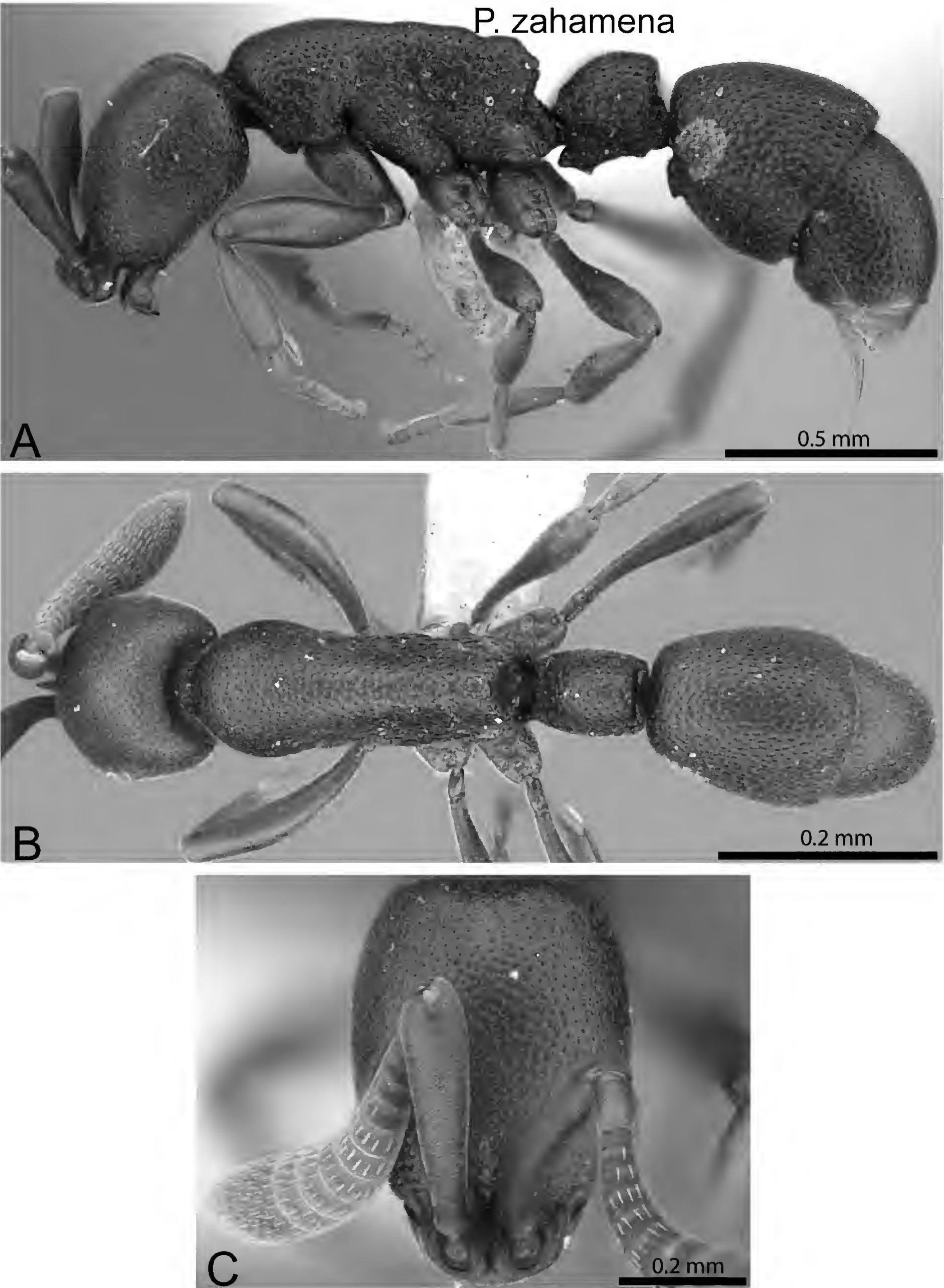
**Paratypes**, ten paratypes with same data as holotype (BMNH: CASENT0247390; CASC: CASENT0150894; CASENT0150896; CASENT0150897; CASENT0150898; CASENT0150899; CASENT0150900; CASENT0247389; MCZ: CASENT0247391).

**Diagnosis.** The following character combination distinguishes *P. zahamena* from the other two Malagasy species: in full-face view head around 1.4 to 1.5 times longer than broad (CI 67–70); SI 99–102; hind tibia around 1.1 to 1.2 times shorter than head width (HTLI 82–89); petiole relatively shorter, higher and stronger arched, in profile (without ventral process) between 1.0 to 1.2 times longer than high (LPNeI 103–116), in dorsal view petiole around 1.2 to 1.3 times longer than broad (DPeI 76–86).

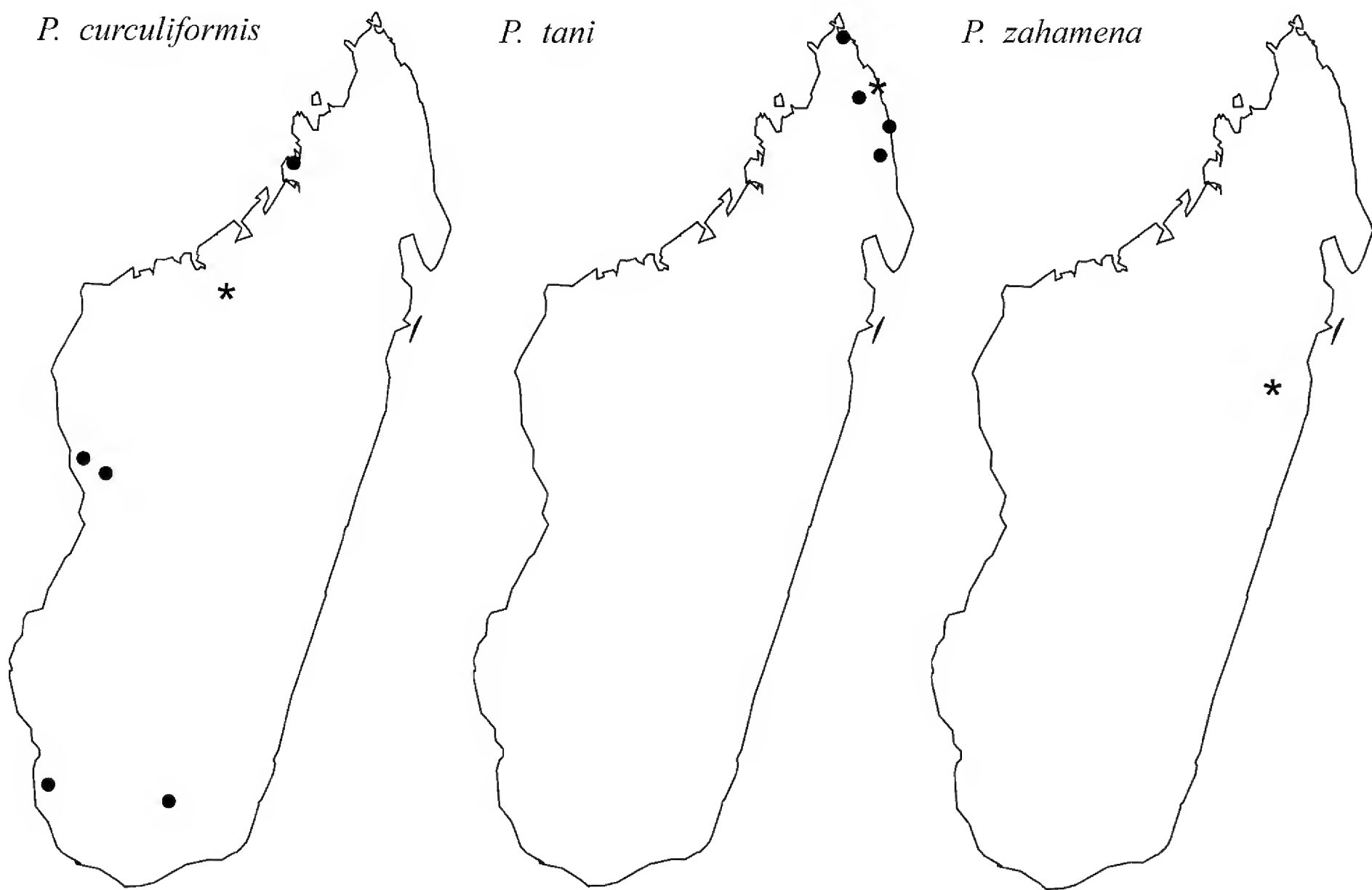
**Worker measurements (N=11).** HL 0.64–0.68 (0.65); HW 43–45 (0.44); SL 43–45 (0.44); WL 0.79–0.87 (0.83); PH 0.28–0.33 (0.30); PW 0.33–0.37 (0.34); HTL 0.37–0.40 (0.38); PeH 0.30–0.34 (0.21); PeNH 0.23–0.25 (0.24); PeNL 0.24–0.29 (0.27); PeW 0.20–0.22 (0.21); CI 67–70 (0.68); SI 99–102 (0.100); LMI 34–38 (36); HTLI 82–89 (86); DPeI 76–87 (81); LPeI 79–86 (83); LPeNI 103–116 (109); PeNI 61–67 (62).

**Worker description.** In full-face view head between 1.4 to 1.5 times longer than broad (CI 67–70), posterior head margin weakly concave; lateral margins of head convex, broadest medially, posterolateral corners rounded; clypeus and anterior part of frons strongly protruding anteriorly as narrow frontoclypeal, subrectangular shelf or socket; antennal sockets exposed and closely approximated, separated by a thin, vertical lamella formed by fused frontal carinae; mandibles small, triangular to elongate-triangular, masticatory margin armed with one larger apical tooth and a series of six smaller denticles, in full-face view mandibles obscured by frontoclypeal shelf; palp formula 4,2; eyes absent; antennae 12-segmented, funicular antennomeres growing in size and width towards apex without forming well defined antennal club, apical antennomere much larger than remaining funicular antennomeres, antennal scape short (SI 99–102), far from reaching posterior head margin. Mesosoma slender, long, and relatively low (LMI 34–38), in profile mesosomal outline relatively flat; propleurae enlarged and projecting ventrally; promesonotal suture absent; metanotal groove present but weak; declivitous face of propodeum margined by low, obtuse, and concave lamella on each side, propodeal lamella posterodorsally with small, blunt tooth, posteroventrally with rounded lobe; posterior declivity of propodeum weakly concave in dorsal view. Legs long and slender; all tibiae





**Figure 5.** *Probolomyrmex zahamena* sp. n. holotype worker (CASENT0914279). **A** Body in profile **B** Body in dorsal view **C** Head in full-face view.



**Figure 6.** Geographic distribution maps of Madagascar for *P. curculiformis*, *P. tani*, and *P. zahanena*. Star symbols represent type localities while circles represent non-type localities.

with single, pectinate spur; pretarsal claws simple without median tooth; hind tibia around 1.1 to 1.2 times shorter than head width (HTLI 82–89). In profile petiole with subpetiolar process around 1.2 times longer than high (LPeI 79–86), petiole without subpetiolar process between 1.0 to 1.2 times longer than high (LPNeI 103–116), petiolar dorsum strongly arched, much higher posteriorly, anterior face curving smoothly onto dorsum without well developed anterodorsal margin, posterior face vertical and concave, enclosed laterally and dorsally by low, thick carina; in dorsal view petiole around 1.2 to 1.3 times longer than broad (DPeI 76–87); pronotum between 1.5 to 1.7 times longer than petiolar width (PeNI 60–67); subpetiolar process well developed and lamelliform, ventral face weakly concave, anteroventral and posteroventral corners well angled, posteroventral portion slightly sharper but not projecting backwards or dentate. Abdominal segment III in profile narrowed anteriorly, broadest posteriorly. Sting well developed and very long. Surface sculpture very conspicuous, throughout whole body densely foveolate overlaying conspicuous very fine, dense, coriaceous microsculpture. Pilosity strongly reduced throughout and virtually absent, except for few short hairs below frontoclypeal shelf, some longer hairs on mandibles, and some short, fine hairs around metapleural gland orifice. Pubescence whitish, extremely fine, very short, and appressed, present over most of body, funicular antennomeres with such pubescence overlaid by much scattered, much longer, appressed hairs. Colour dark reddish brown, appendages light brown.

**Etymology.** The new species is named after the type locality, the Zahamena National Park in eastern Madagascar. Zahamena is part of the UNESCO World Heritage Site “Rainforests of the Atsinanana”, and considered as one of the WWF’s Global 200 priority eco-regions for conservation priority. By naming the new species after this locality we want to draw attention to this very important locality with its high conservation value. The species epithet is treated as a noun in apposition, and thus invariant.

**Distribution and biology.** At present, *P. zahanena* is only known from the type locality, which is a tropical rainforest situated at an elevation of 780 m. All the available material is from a single leaf litter collection. It is surprising that *P. zahanena* is the only known species found in eastern Madagascar, especially considering the very high leaf litter sampling effort performed by the Malagasy ant project from 1992 to the present. This suggests that the species is either comparatively rare or predominantly hypogaeic. As for the other two species, the use of soil sampling methods might yield additional material.

**Discussion.** *Probolomyrmex zahanena* is fairly distinct and its identification straightforward. The shape of the petiole, which is relatively short, high and stout, distinguishes it clearly from *P. tani*, while the presence of a metanotal groove separates it from *P. curculiformis*. In addition, *P. zahanena* has a slightly broader head (CI 67–70) than the other two (CI 62–66).

**Variation.** Since *P. zahanena* is only known from one collection event, the observable variation is insignificant.

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We are thankful to Michele Esposito, April Nobile, and Erin Prado for image processing and/or databasing. Also, we acknowledge the support of the Museum für Naturkunde Berlin for publishing the manuscript as free open access publication. In addition, we thank one anonymous reviewer and Mag. Dominique Zimmermann from the Naturhistorisches Museum Wien, Austria, for reviewing and commenting on the manuscript. The fieldwork on which this study is based on could not have been completed without the gracious support of the Malagasy people and the Arthropod Inventory Team (Balsama Rajemison, Jean-Claude Rakotonirina, Jean-Jacques Rafanomezantsoa, Chrislain Ranaivo, Hanitriniana Rasoazanamavo, Nicole Rasoamanana, Clavier Randrianandrasana, Dimby Raharinjanahary). This study was supported by the National Science Foundation under Grant No. DEB-0072713, DEB-0344731, and DEB-0842395. FHG was granted two Ernst Mayr Travel Grants from the MCZ to visit the collections at BMNH and MCZ.

## References

- Agosti D (1994) A revision of the South American species of the ant genus *Probolomyrmex* (Hymenoptera: Formicidae). *Journal of the New York Entomological Society* 102: 429–434.
- Bolton B (2003) Synopsis and classification of Formicidae. *Memoirs of the American Entomological Institute* 71: 1–370.
- Bolton B (2014) An online catalog of the ants of the world. <http://antcat.org> [accessed 26 February 2014]
- Eguchi K, Yoshimura M, Yamane S (2006) The Oriental species of the ant genus *Probolomyrmex* (Insecta: Hymenoptera: Formicidae: Proceratiinae). *Zootaxa* 1376: 1–35.
- Evenhuis NL (2014) The insect and spider collections of the world website. <http://hbs.bishopmuseum.org/codens> [accessed 26 February 2014]
- Fisher BL (2005) A model for a global inventory of ants: A case study in Madagascar. *Proceedings of the California Academy of Sciences* 56: 86–97.
- Fisher BL (2007) A new species of *Probolomyrmex* from Madagascar. *Memoirs of the American Entomological Institute* 80: 146–152.
- Forel A (1910) Ameisen aus der Kolonie Erythrea. Gesammelt von Prof. Dr. K. Escherich (nebst einigen in West-Abessinien von Herrn A. Ilg gesammelten Ameisen). *Zoologische Jahrbücher, Abteilung für Systematik, Geographie und Biologie der Tiere* 29: 243–274.
- Ito F (1998) Colony composition and specialized predation on millipedes in the enigmatic ponerine ant genus *Probolomyrmex* (Hymenoptera, Formicidae). *Insectes Sociaux* 45: 79–83. doi: 10.1007/s000400050070
- Keller RA (2011) A phylogenetic analysis of ant morphology (Hymenoptera, Formicidae) with special reference to the poneromorph subfamilies. *Bulletin of the American Museum of Natural History* 355: 1–90. doi: 10.1206/355.1
- Mayr G (1901) Südafrikanische Formiciden, gesammelt von Dr. Hans Brauns. *Annalen des Kaiserlich-Königlichen Naturhistorischen Museums in Wien* 16: 1–30.
- O’Keefe S, Agosti D (1997) A New Species of *Probolomyrmex* (Hymenoptera: Formicidae) from Guanacaste, Costa Rica. *Journal of the New York Entomological Society* 105: 190–192.
- R Core Team (2014) R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria. <http://www.R-project.org> [accessed 24 February 2014]
- Shattuck SO, Gunawardene NR, Heterick B (2012) A revision of the ant genus *Probolomyrmex* (Hymenoptera: Formicidae: Proceratiinae) in Australia and Melanesia. *Zootaxa* 3444: 40–50.
- Tanaka M (1974) Description of a new species of ant of the genus *Probolomyrmex* from Malaysia. *Entomological Review of Japan* 26: 35–37.
- Taylor RW (1965) A monographic revision of the rare tropicopolitan ant genus *Probolomyrmex* Mayr (Hymenoptera: Formicidae). *Transactions of the Royal Entomological Society of London* 117: 345–365. doi: 10.1111/j.1365-2311.1965.tb00044.x
- Terayama M, Ogata K (1988) Two new species of the ant genus *Probolomyrmex* (Hymenoptera, Formicidae) from Japan. *Kontyu* 56: 590–594.
- Xu Z, Zeng G (2000) Discovery of the worker caste of *Platythyrea clypeata* Forel and a new species of *Probolomyrmex* Mayr in Yunnan, China. *Entomologia Sinica* 7: 213–217.

# A new oak-feeding species of *Lachnus* Burmeister and some remarks on the taxonomic status of *L. chosoni* Szelegiewicz (Hemiptera, Aphididae, Lachninae)

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## Abstract

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## Key Words

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taxonomy

A new species, *Lachnus pseudonudus* Kanturski & Wieczorek, **sp. n.**, associated with *Quercus ithaburens* subsp. *macrolepis* is described and figured in detail from specimens collected in Turkey. The lectotype and paralectotypes of *L. crassicornis*, a species associated with *Quercus ithaburens* subsp. *ithaburens*, are designated. The taxonomic position of *L. chosoni*, a poorly known species from Korea previously treated as a synonym of *L. pallipes*, is discussed. Morphological and biometric characters of the studied species are given. An identification key to species belonging to the “*pallipes*” group is provided.

## Introduction

The genus *Lachnus* Burmeister, 1835 comprises about 20 species associated with deciduous trees from the genera *Castanea*, *Castanopsis*, *Fagus*, *Quercus* (Fagaceae), *Hippophae* (Eleagnaceae), *Salix* (Salicaceae), *Ficus* (Moraceae) and *Casuarina* (Casuarinaceae) and living on the bark of tree trunks, branches or main roots (Heie 1995; Binazzi and Remaudière 2010). Aphids from this genus are characterised by medium to large body size, long hind legs and pigmented wings in alatae. Key morphological features of *Lachnus* include also the terminal process of the antenna with 2–7 subapical setae, and primary rhinaria with a sclerotic rosette. The apical segment of the rostrum is short and with a button-shaped apical part (Szelegiewicz 1978; Blackman and Eastop 1994). Among representatives of the genus *Lachnus*, most species are

Fagaceae-feeders, associated mostly with oaks (*Quercus* spp.). According to Binazzi and Remaudière (2010), this group of species living on the Fagaceae can be divided into subgroups with or without distinct mesosternal tubercles in apterous viviparous females. The group lacking these tubercles comprises *L. crassicornis* Hille Ris Lambers, 1948, *L. longirostris* (Mordvilko, 1901) and *L. pallipes* (Hartig, 1841) (the “*pallipes*” group) and is characterised also by very long setae on the apical part of the hind tibiae in addition to the normal ones. Among the above mentioned species the status of *L. longirostris* is questionable; i.e. this species is treated as a synonym of *L. pallipes* (Szelegiewicz 1975; Blackman and Eastop 1994), which has been confirmed by recent molecular studies (Mróz et al. 2013). Moreover, the species *L. chosoni* Szelegiewicz, 1975 seems to be closely related to this group, also treated by some authors as a synonym of

*L. pallipes* (Blackman and Eastop 1994, 2014; Remaudière and Remaudière 1997). In addition, Blackman and Eastop (1994, 2014) suggested that in the collection of the Natural History Museum, London, UK (BMNH) specimens determined as *L. crassicornis* but most probably belonging to an undescribed species related to the “*pallipes*” group are present.

The aim of this paper is to define the taxonomic status of the species belonging to the “*pallipes*” group. On the basis of the material deposited in the BMNH a new, hitherto unknown species is described. The lectotype and paralectotypes of *L. crassicornis* are designated. Based on a reinvestigation of the type material of *L. chosoni* deposited in the Zoological Institute, Polish Academy of Sciences, Warsaw, Poland (ZMPA) the status of this species is discussed. An identification key to species belonging to the “*pallipes*” group is provided.

## Material and methods

### Material examined.

- L. chosoni*.** Holotype: one apterous viviparous female, KOREA, Myohyang-san Mts. 05.VIII.1959, *Quercus* sp., no APH-4704 B. Pisarski & J. Prószyński leg. ZMPA. Paratypes. Same locality as holotype: two apterous viviparous females, no APH-4705, ZMPA.
- L. crassicornis*.** Lectotype: one apterous viviparous female marked as 1, ISRAEL, Daphne, 28.IV.1945, *Quercus ithaburensis* (Univ. Jerusalem), no BM 1984-340a (present designation) BMNH. Paralectotypes. Same locality as lectotype: three apterous viviparous females marked as 2, 3, 4, no BM 1984-340a; four apterous viviparous females marked as 1, 2, 3, 4 no BM 1984-340b (present designation) BMNH.
- L. pallipes*.** Three apterous viviparous females POLAND, Międzyzdroje, 10.VIII.1965, *Fagus sylvatica*, no R 2316, 2718, H. Szelegiewicz leg. (ZMPA), seven apterous viviparous females, POLAND, Borne Sulnowo, 26.VI.2012, *Q. robur*, no Ł56, Ł. Depa leg., four apterous viviparous females, SLOVAKIA, Palcmanška Masa, 02.VIII.2012, *F. sylvatica*, no L470, Ł. Depa leg. Department of Zoology, University of Silesia, Poland (UŚ)

The specimens were examined using the light microscope Nikon Ni-U. Drawings were made with a camera lucida. Measurements are given in mm (Table 1 and 2). Measurements and ratios of the first segment of hind tarsus (HT I) were made according to Szelegiewicz (1978) and Heie (1995).

The holotype and paratypes of the new species are deposited in the Natural History Museum London, UK, (BMNH). Paratypes will be also deposited in the aphids collection of the Department of Zoology, University of Silesia, Poland (UŚ).

## Results

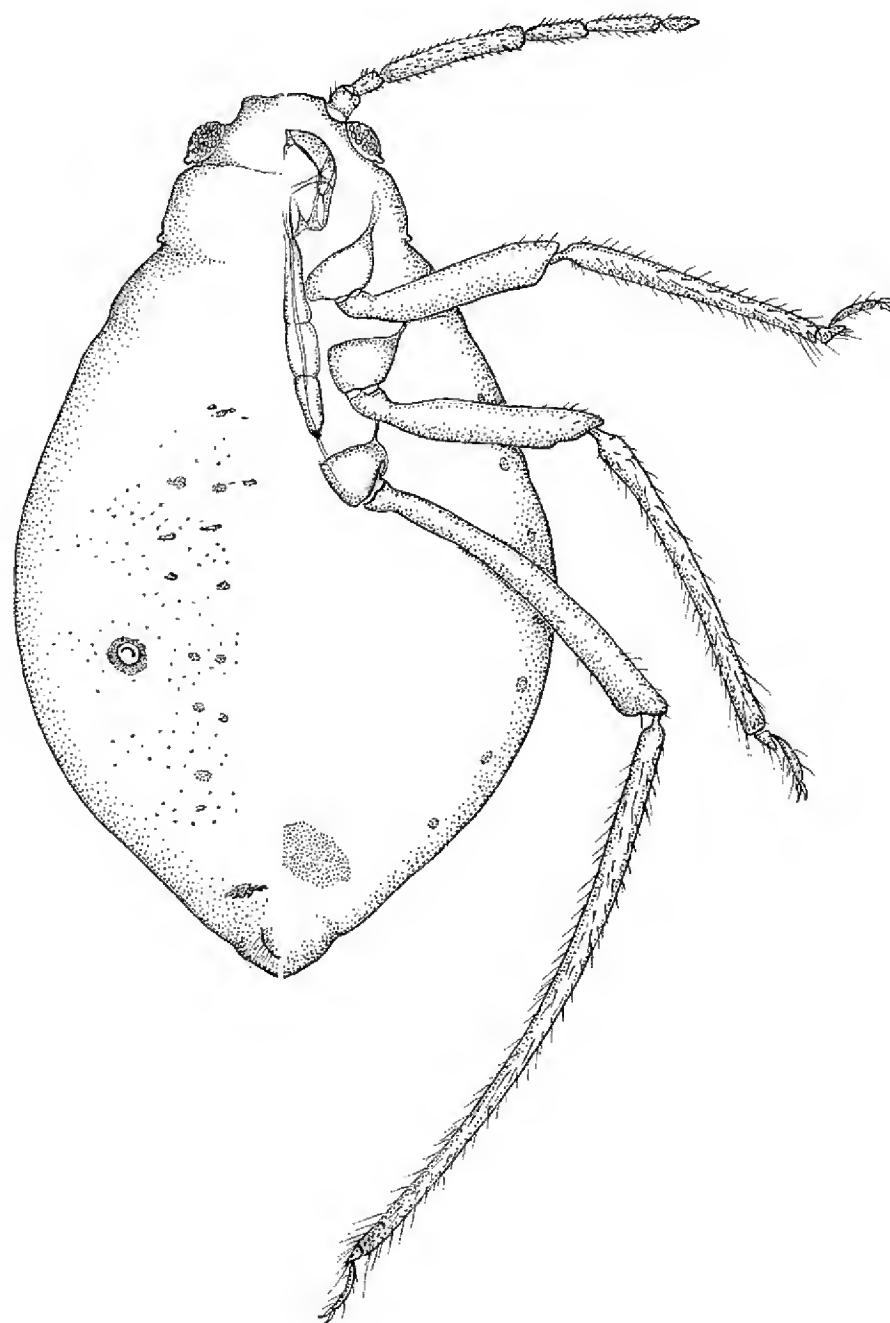
### *Lachnus pseudonudus* Kanturski & Wieczorek, sp. n.

<http://zoobank.org/4C5ABFBE-C6DB-4440-B08E-42CF496472BB>

[http://species-id.net/wiki/Lachnus\\_pseudonudus](http://species-id.net/wiki/Lachnus_pseudonudus)

Figures 1, 2, 3; Table 1, 2

**Description. Apterous viviparous female.** Colour in life unknown. Pigmentation of mounted specimens: head, pronotum and mesonotum sclerotised, covered by light brown sclerotic shield. Antennal segments light brown. Fore and middle femora light brown, hind femora brown with pale proximal area to about  $\frac{1}{4}$  length. Tibiae from proximal part to about  $\frac{1}{2}$  length and on distal parts brown, otherwise yellowish (Fig. 3a). Tarsi brown. Abdomen pale. Siphuncular sclerites pale to light brown. Subgenital and anal plate brown. Body large, egg-shaped (Fig. 1). Head densely covered by short, thick and forked setae, shorter than setae on antennal segments. Frons flat. Head width 0.49–0.57 times length of antennae. Antennae 6-segmented (Fig. 2a), 0.44–0.53 times length of body. Ant. segm. III slightly shorter than ant. segm. IV+V+VI, with 0–1 secondary rhinarium. Ant. segm. IV slightly shorter than, or as well as long as ant. segm. V, with 0–3 secondary rhinaria. Ant. segm. V always longer than ant. segm. VI with 1 primary and 1–2 accessory



**Figure 1.** *Lachnus pseudonudus* Kanturski & Wieczorek, sp. n. – apterous viviparous female: general view.



**Table 1.** Measurements (in mm) of apterous viviparous females (n = 8) *Lachnus pseudonudus* Kanturski & Wieczorek, sp. n. from the type material. Measurements of the holotype bolded.

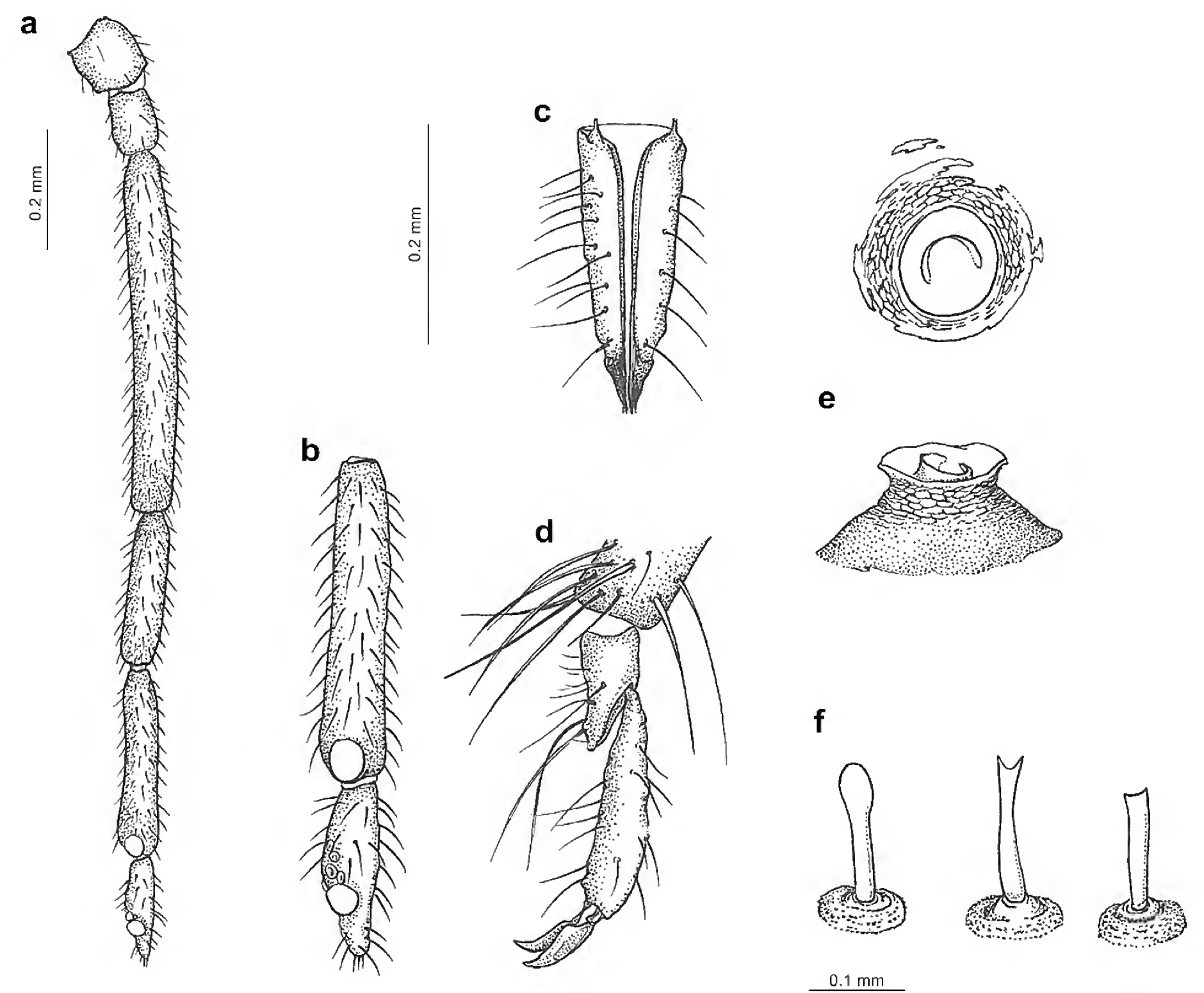
Character	Apterous viviparous females							
Length of body	<b>3.60</b>	3.20	3.05	3.00	2.62	2.87	2.87	2.95
Maximal width of body	<b>2.25</b>	1.77	1.65	1.52	1.40	1.50	1.55	1.55
Head width across compound eyes	<b>0.81</b>	0.75	0.76	0.74	0.72	0.73	0.73	0.72
Length of antennae	<b>1.60</b>	1.51	1.52	1.36	1.35	1.40	1.43	1.33
Length of antennal segment III	<b>0.64</b>	0.60	0.58	0.53	0.50	0.54	0.51	0.56
segment IV	<b>0.27</b>	0.26	0.27	0.22	0.22	0.25	0.21	0.24
segment V	<b>0.31</b>	0.27	0.30	0.25	0.27	0.26	0.25	0.26
segment VIa	<b>0.13</b>	0.11	0.12	0.11	0.12	0.11	0.11	0.12
segment VIb	<b>0.03</b>	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Length of rostrum	<b>1.50</b>	1.60	1.60	1.65	1.50	1.62	1.80	1.90
Length of apical segment of rostrum	<b>0.25</b>	0.25	0.24	0.26	0.26	0.25	0.24	0.25
Length of hind femora	<b>1.35</b>	1.30	1.35	1.25	1.15	1.20	1.15	1.25
Length of hind tibiae	<b>2.55</b>	2.47	2.50	2.30	2.17	2.27	2.20	2.37
Length of hind tarsi segm. I	<b>0.11</b>	0.12	0.11	0.11	0.10	0.12	0.11	0.12
Length of hind tarsi segm. II	<b>0.23</b>	0.23	0.23	0.22	0.22	0.22	0.23	0.22
Siphuncular sclerite diameter	<b>0.18</b>	0.21	0.18	0.18	0.19	0.20	0.22	0.18
Siphuncular cone diameter	<b>0.10</b>	0.10	0.10	0.09	0.11	0.10	0.09	0.10
Subgenital plate length	<b>0.29</b>	0.28	0.26	0.25	0.24	0.26	0.26	0.27
Subgenital plate width	<b>0.53</b>	0.50	0.52	0.47	0.45	0.46	0.42	0.48

**Table 2.** The main morphological and biometric differences among *Lachnus crassicornis* and *L. pseudonudus* Kanturski & Wieczorek, sp. n. **BL** – body length, **HLL** – hind leg length, **AL** – antennae length, **ANT VI** – antennal segment VI length, **ANT III** – antennal segment III length, **HT I** – first segment of hind tarsus length, **HT II** – second segment of hind tarsus length.

Character	<i>Lachnus crassicornis</i>	<i>Lachnus pseudonudus</i> Kanturski & Wieczorek, sp. n.
Dorsal chaetotaxy	Thorax and abdomen very densely covered by very thin, fine and pointed setae, 0.037–0.050 mm long	Thorax and abdomen covered by very short, inconspicuous setae, arranged in 3–4 rows on each segment with blunt, capitate, spatulate or club-shaped apices, 0.010–0.020 mm long
Head setae	As long as setae on antennae, fine with pointed apices	Shorter than setae on antennae, slightly thick and forked
Antennae	Antennal segments swollen	Antennal segments not swollen
Siphunculi	Siphuncular sclerites very low, siphunculi almost poriform, with little-developed flange with 2–3 rows of polygonal reticulation	Siphuncular sclerites well-developed, with very well-developed flange with 8–10 rows of polygonal reticulation
Abdominal cuticle	Smooth	Wrinkled or reticulated
Hind tibiae chaetotaxy	Some setae on distal part of tibiae 3–4 times longer than other setae, 0.14–0.15 mm long	Some setae on distal part of tibiae 4–5 times longer than other setae, 0.17– 0.22 mm long
HT I setae	12	14
HLL/BL	1.47–1.68	1.18–1.45
AL/BL	0.57–0.64	0.44–0.53
ANT VI/ANT III	0.19–0.25	0.25–0.31
HT II/ANT III	0.27–0.36	0.36–0.45

rhinaria. Ant. segm. VI base (IVa) longer than terminal process (IVb), with 1 big primary rhinarium with sclerotised rosette and 6–7 small accessory rhinaria, adjoining each other (Fig. 2b). IVb 0.24–0.33 times length of VIa with 3 apical and 5–7 subapical setae, which are shorter and slightly thicker than basal setae. Other antennal ratios: VI:III 0.25–0.31; V:III 0.44–0.54; IV:III 0.37–0.48; IV:V 0.80–1.03. Ant. segm. I–VIa densely covered with very thin, hair-like, pointed setae. Longest seta on ant. segm. III 1.10–1.66 times basal articular diameter of this segment. Rostrum long, reaching siphunculi or genital plate (in some specimens reaching only hind coxae). Apical segment of rostrum (ARS) pointed, 0.38–0.50 times ant. segm. III and 1.00–1.19 times second segment of

hind tarsus (HT II), with 4 primary and 18 accessory setae (Fig. 2c). Mesosternal tubercles absent. Hind legs long, 1.18–1.45 times length of body. Some setae on hind tibiae 4–5 times longer than other setae, hair-like, 0.17–0.22 mm long (Figs 2d, 3a). First segment of hind tarsus (HT I) with 14 ventral setae (Fig. 2d). HT II 0.36–0.45 times ant. segm. III and 1.37–1.50 times ant. segm. VI. Abdomen membranous, cuticle with very densely wrinkled surface in transverse rows. Siphuncular sclerites well-developed, usually slightly oval, around pore a very well-developed flange with 8–10 rows of polygonal reticulation (Figs 2e, 3e). Dorsal abdominal segments covered with 3–4 rows of very short, blunt, capitate, spatulate or club-shaped setae, 0.010–0.020 mm long, arising from dark brown ring-like



**Figure 2.** *Lachnus pseudonudus* Kanturski & Wieczorek, sp. n. – apterous viviparous female: (a) antenna, (b) antennal segment V and VI, (c) apical segment of rostrum, (d) distal part of hind tibia and tarsus, (e) siphunculus, (f) dorsal abdominal setae.

bases (Fig. 2f). Each abdominal segment with 3 pairs of brown, rounded sclerites. Subgenital plate well-developed, with indentation from posterior side. Cauda circular or semicircular with 22–24 long and pointed setae which are longer and thicker than those on legs. Anal plate well-developed, sclerotised.

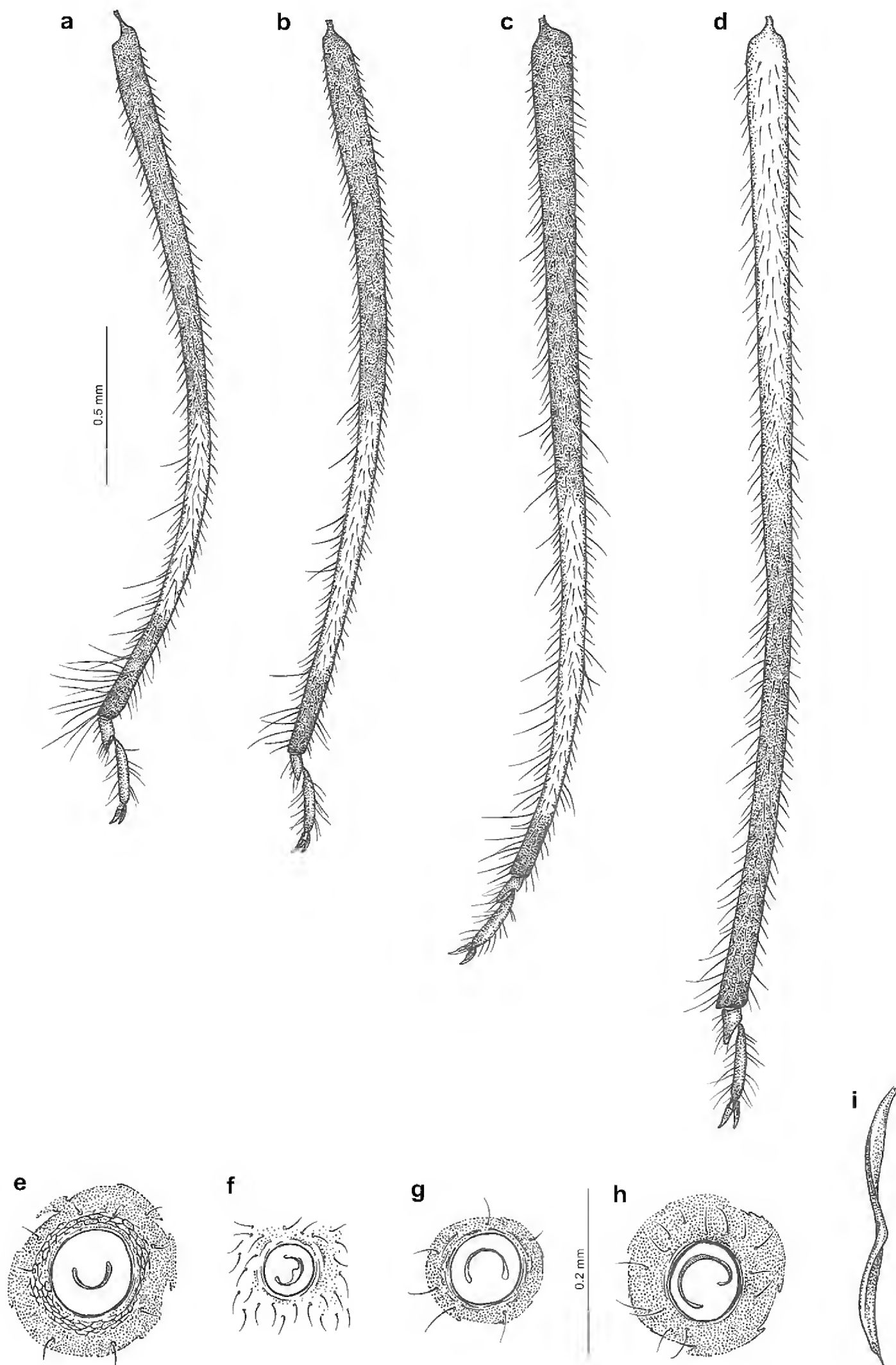
**Diagnosis.** The new species can be distinguished from *L. crassicornis* as well as from the other *Lachnus* species by the sparse dorsal chaetotaxy and extremely short, inconspicuous setae with blunt, slightly spatulate, capitate or club-shaped apices. The new species is also characterised by siphunculi with a very well-developed and almost transparent flange with 8–10 rows of polygonal reticulation. Main morphological and biometric differences between *L. pseudonudus* Kanturski & Wieczorek, sp. n. and *L. crassicornis* are given in Table 2.

**Etymology.** The name of the new species is derived from characteristically short and inconspicuous setae on the dorsal part of the thorax and the abdomen.

**Biology and host plant.** The species live on branches and shoots of *Q. ithaburensis* subsp. *macrolepis*

**Table 3.** The main morphological and biometric differences among *Lachnus chosoni* and *L. pallipes*. **BL** – body length, **HLL** – hind leg length, **ARS** – apical rostrum segment, **HT II** – second segment of hind tarsus, **HT I** – first segment of hind tarsus.

Character	<i>Lachnus chosoni</i>	<i>Lachnus pallipes</i>
ant. segm. VI/ant. segm. III	0.25–0.31	0.21–0.24
ant. segm. V/ant. segm. III	0.34–0.40	0.40–0.41
ant. segm. IV/ant. segm. V	1.00–1.10	0.78–0.96
BL/HLL	0.65–0.68	0.74–0.83
HLL/BL	1.45–1.52	1.19–1.34
ARS/HT II	0.79–0.84	0.96–1.00
ARS/ant. segm. VI	1.00–1.06	1.26–1.38
Siphuncular sclerite diameter	0.24–0.24	0.15–0.20
HT I basal/HT I ventral	0.29–0.33	0.33–0.40
HT I basal/HT I intersegmental	0.50–0.52	0.60–0.66
HT II/ant. segm. III	0.34–0.37	0.30–0.33
Hind tibiae setae length	0.12–0.14	0.15–0.16
Mesosternal tubercles	Present but very small	Absent
Hind tibiae	Uniformly dark brown with paler proximal part	Brown on distal and proximal parts with pale area for about 1/3 of length



**Figure 3.** Main differences in pigmentation and chaetotaxy of hind tibiae and size of siphuncular sclerites among apterous viviparous females of the “*pallipes*” group: (a, e) *Lachmus pseudonudus* Kanturski & Wiczorek, sp. n., (b, f) *L. crassicornis*, (c, g) *L. pallipes*, (d, h) *L. chosoni*, (i) small mesosternal tubercles of *L. chosoni*.

(Kotschy) Hedge & Yalt. (= *Q. aegilops*) and is visited by the ant species *Liometopum microcephalum* (Panzer, 1798) (Canakçioğlu 1975).

**Distribution.** Turkey, Uşak-Eşme.

**Material examined.** Holotype: one apterous viviparous female marked as 1. TURKEY, Uşak-Eşme, 850 m, 10.VI.1964, no 731/64, 45a1, M. Canakçioğlu leg. BMNH.

Paratypes. Same locality as holotype: one apterous viviparous female marked as 2, no 731/64, 45a1; four apterous viviparous female marked as 1, 2, 3, 4, no 731/64, 45a2 BMHN; four apterous viviparous female marked as 1, 2, 3, 4, no 731/64, 45a3 UŞ.

Other material examined: 22 apterous viviparous females, same locality as holotype: no 731/64, 45a4–45a9 BMHN.

### Key to apterous viviparous females of the “*pallipes*” group of the genus *Lachnus*

- 1 Siphunculi almost poriform with almost invisible sclerites (Fig. 3f). Dorsum covered with thin, long, hair-like and pointed setae, which are almost similar to ventral setae ..... *Lachnus crassicornis* Hille Ris Lambers
- Siphunculi with well-developed sclerites (Fig. 3e, g, h). Dorsal setae variable but always different from setae on ventral side ..... 2
- 2 Dorsal abdominal setae short and inconspicuous (max 0.02 mm) with blunt, capitate or club-shaped apices, and arising from large, ring-like bases (Fig. 2f) ..... *Lachnus pseudonudus* Kanturski & Wieczorek, sp. n.
- Setae on dorsal side of abdomen always longer than 0.037 mm and pointed, not arising from large, ring-like bases... 3
- 3 Hind tibiae brown on distal and proximal parts with pale area for about 1/3 of length (Fig. 3c). Ant. segm. IV/ant. segm. V 0.78–0.96, ARS/ant. segm. VI 1.26–1.38, ARS/HT II 0.96–1.00 ..... *Lachnus pallipes* Hartig
- Hind tibiae with distal part uniformly dark brown and proximal part paler (Fig. 3d). Ant. segm. IV/ant. segm. V 1.00–1.10, ARS/ant. segm. VI 1.00–1.06, ARS/HT II 0.79–0.84 ..... *Lachnus chosoni* Szelegiewicz

## Discussion

The Fagaceae-feeding species of the genus *Lachnus* form morphologically related groups (Binazzi and Remaudière 2010). The “*pallipes*” group is characterised by the lack of mesosternal tubercles and two types of setae on the hind tibiae: setae as long as or slightly longer than the diameter of the middle part of the tibiae, and some which are distinctly longer. In this group of species *L. pallipes* is characterised by the longest tibial setae situated not only on the posterior part of the tibiae but usually also distributed individually along almost the whole length of the tibiae. In that species, the body is also covered with numerous setae, but contrary to *L. crassicornis* and *L. pseudonudus* Kanturski & Wieczorek, sp. n. the setae of *L. pallipes* are much thicker and with brown pigmentation. On the other hand, the chaetotaxy of the body and the form and shape of the siphunculi clearly distinguish *L. crassicornis* from other *Lachnus* species. All setae of *L. crassicornis* are very thin and hair-like with pointed apices. Only the setae on the posterior parts of tibiae are slightly thicker and much longer than others. The setae on the dorsal part of the abdomen are almost identical with the setae on the ventral side. Probably the long, hair-like and pointed setae on the ventral side of the abdomen and the same host plant were the reasons why the slides of *L. pseudonudus* sp. n. were wrongly determined by Canakçioğlu as *L. crassicornis* and the latter was listed in the aphidofauna of Turkey by the author (Canakçioğlu 1966, 1967, 1975). Dorsal setae of *L. pseudonudus* sp. n. are extremely short and inconspicuous, so they probably were overlooked during the examination of the material. However, the shape of the siphunculi, as well as the very well-developed flange with reticulation and other distinctive morphological and biometric features (see Table 2) give the new species a clear and separate taxonomic position within the genus *Lachnus*. Both *L. crassicornis* and *L. pseudonudus* sp. n. are known from single localities. *L. crassicornis* was recorded only from two localities in Israel, Daphne and Hotshat (Binazzi and Remaudière 2010; the record of this species from *Q. robur* in Romania reported by Holman and Pintera 1981 needs confirmation) whereas *L. pseudonudus* sp. n. is only known

from its type locality in Turkey. The available material confirms the same host plant for both species: *Q. ithaburensis* (Decne). The Tabor oak includes two subspecies – *Q. ithaburensis* subsp. *macrolepis* (Kotschy) Hedge & Yalt. and *Q. ithaburensis* Decne. subsp. *ithaburensis*. These two subspecies of the Tabor oak occur separately in two Mediterranean subregions i.e. *Q. ithaburensis* subsp. *ithaburensis* is known only from Israel and north-western Jordan, whereas *Q. ithaburensis* subsp. *macrolepis* occurs in the western part of Turkey and in an enclaved region eastward to Ankara (Drufour-Dror and Ertas 2004). As the two subspecies of the Tabor oak do not overlap in their occurrence it is argued that *L. crassicornis* is associated with *Q. ithaburensis* subsp. *ithaburensis*, and *L. pseudonudus* sp. n. with *Q. ithaburensis* subsp. *macrolepis*, which additionally corroborates the separateness of those two species.

Similarly, *L. chosoni* is a rare aphid species, which is known only from the type locality in Myohyang-san (Korea) and all material, including the types, comprises three apterous viviparous females. Although Szelegiewicz (1975) provided a detailed description and drawings of this species, its taxonomic position was undermined and it was treated as a synonym of *L. pallipes* (Blackman and Eastop 1994, 2014; Remaudière and Remaudière 1997). On the other hand, Binazzi and Remaudière (2010) gave *L. chosoni* full species status. However, the authors underlined that it was keyed only on the basis of the data from the original Szelegiewicz’s description without studying the type material and still there were doubts about the possible synonymy of these species. A comparison of the type material of *L. chosoni* and *L. pallipes* from various localities, biometric ratios of the lengths of antennal segments, the apical segment of the rostrum and the hind tarsus clearly show differences between those species (see Table 3). Moreover, *L. chosoni* is characterised by the larger siphuncular sclerite diameter, different colouration of the hind tibiae and, most conspicuously, very small mesosternal tubercles (Figs 3c, g, i). Species belonging to the “*pallipes*” group, including *L. pseudonudus* sp. n., are characterised by the absence of those structures, unlike the remaining Fagaceae-feeding species of the genus *Lachnus* (especially the *Quercus* spp. inhabitants,



Özdemir et al. 2005), which have prominent mesosternal tubercles. However, the presence of longer and shorter setae on hind tibiae, which is also a unique character of the “*pallipes*” group, indicates a close relation of *L. chosoni* with this group of species.

## Acknowledgements

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## References

- Binazzi A, Remaudière G (2010) The Palearctic – Oriental Fagaceae – feeding species of *Lachmus* Burmeister (Hemiptera Aphididae Lachninae). Redia XCIII: 45–73.
- Blackman RL, Eastop VF (1994) Aphids on the World's Trees. CAB International, Wallingford, 987 pp.
- Blackman RL, Eastop VF (2014) Aphids of the World's Plants: an Online Identification and Information Guide. <http://www.aphidson-worldsplants.info/>
- Çanakçıoğlu H (1966) Türkiye’ de orman ağaçlarına arız olan bitki bitleri (Aphidoidea) üzerine araştırmalar (A study of the forest Aphidoidea of Turkey). Istanbul Üniversitesi Orman Fakültesi Dergisi, Seri A, Cilt XVI (2): 90-131.
- Çanakçıoğlu H (1967) Türkiye’ de orman ağaçlarına arız olan bitki bitleri (Aphidoidea) üzerine araştırmalar. T.C. Tarım Bakanlığı, Orman Genel Müd. Yayınları Sıra 466, Seri No: 22, VIII, 151 pp.
- Çanakçıoğlu H (1975) The Aphidoidea of Turkey - Istanbul Univ. Orman Fak. Yayınları, Nâ 1751, 309 pp.
- Drufour-Dror JM, Ertas A (2004) Bioclimatic perspectives in the distribution of *Quercus ithaburensis* Decne. subspecies in Turkey and Levant. Journal of Biogeography 31: 461–474. doi: 10.1046/j.0305-0270.2003.01036.x
- Heie OE (1995) The Aphidoidea of Fennoscandia and Denmark VI. Aphidinae. Part 3 of Macrosiphini and Lachnidae. Fauna entomologica scandinavica 31, 222 pp.
- Holman J, Pintera A (1981) Übersicht der Blattläuse (Homoptera, Aphidoidea) der Rumänischen Sozialistischen Republik. Studie CSAV (Prague) 15: 1–125.
- Mróz E, Trela J, Depa Ł (2013) Molecular and morphological differentiation of *Lachmus pallipes* (Hartig) and *L. roboris* (L.). 9<sup>th</sup> International Symposium on Aphids, Beijing, China, 2nd-6th June 2013. Abstracts book, 37.
- Özdemir I, Remaudière G, Toros S, Kiliçer N (2005) New Aphid Records from Turkey including the description of a new *Lachmus* Species (Hemiptera Aphididae). Revue française d'Entomologie (N.S.) 27(3): 97–102.
- Remaudière G, Remaudière M (1997) Catalogue des Aphididae du monde Homoptera Aphidoidea. Institut national de la Recherche scientifique, Paris, France, 474 pp.
- Szelegiewicz H (1975) Two new Lachnid species (Homoptera, Lachnidae) from Korea. Polskie Pismo Entomologiczne 45: 575–581.
- Szelegiewicz H (1978) Klucze do oznaczania owadów Polski. XVII, Homoptera, 5a, Mszyce – Aphidodea, 1, Lachnidae, 107 pp.



## Book review: Insect morphology and phylogeny

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Beutel RG, Friedrich F, Ge S-Q, Yang X-K (2014) **Insect Morphology and Phylogeny: A textbook for students of entomology**. De Gruyter, Berlin/Boston, 516 pp., soft-cover. ISBN 978-3-11-026263-6.

As the authors were driving forces in the recent revival of morphology it is just and equitable that they free us from the dependence on timeworn reams. A new standard work on insect morphology and phylogeny has been long overdue and will certainly constitute a valuable reference for future publications.

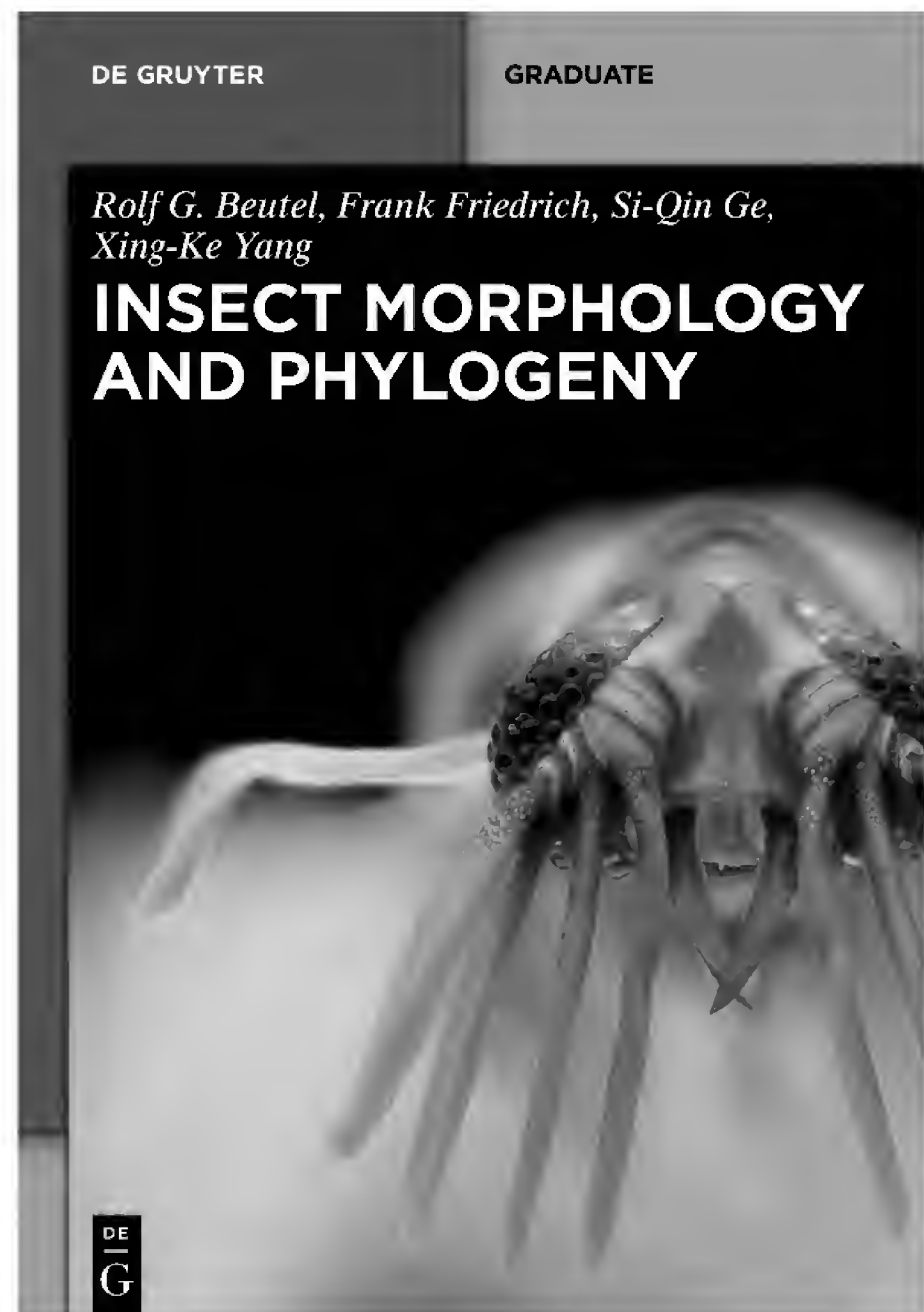
This textbook is a comprehensive treatment covering morphology, phylogeny, and associated methods as traditional and modern morphological techniques and phylogenetic reconstruction. It starts with a state of the art description of general hexapod morphology, supplemented with a useful separate glossary of morphological terms. The recently defined and currently applied nomenclature for the muscles of the head and the thorax is outlined in two tables. In the section on morphological techniques the authors incorporate their personal experience and discuss advantages and problems of the respective method which gives this chapter additional value.

The second part of the book deals with the 35 currently recognized hexapod orders. These chapters do not only contain detailed morphological descriptions of adults and larvae including internal anatomy if investigated, but also information on diversity and distribution, taxonomy, reproductive behaviour and development, fossil record and the economic importance of the order. The relationship of the orders is presented in several cladograms, controversial phylogenetic hypotheses are discussed and autapomorphies of the orders and higher clades are listed. In the chapter “literature“ the additional listing of textbooks, review articles and cladistic software gives students a quick overview on further reading.

Generally the structure of the book is clear and intuitive. The absence of separate subtopics for the sections on phylogenetic relationships is however a neglect. The only way to find this information is paging

through the whole chapter “The orders of Hexapoda“ again and again which is rather tiring. We suggest preparing some post-it notes before starting to read.

Altogether, the book gives the only complete and modern reference of its kind available today. The authors manage to communicate even complicated topics in an easily understandable way, not at least by enhancing the text with numerous detailed drawings, excellent scanning electron micrographs, coloured 3-D reconstructions and photographs of living specimens. Their in-depth knowledge combined with their enthusiasm for the topic make this book attractive not only for students and researchers but for everyone interested in entomology.









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